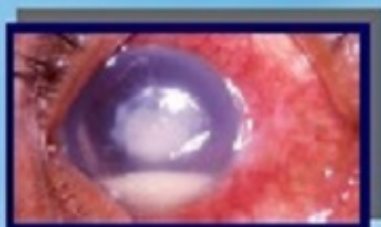
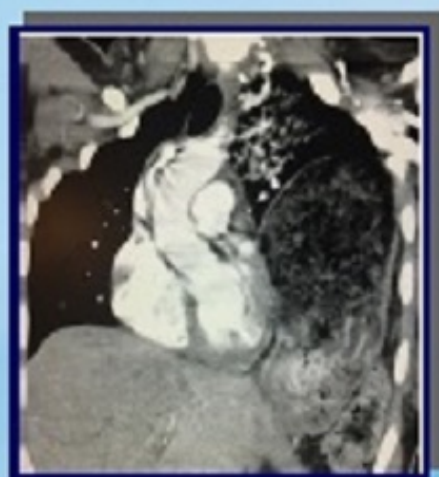


THE ULTIMATE EMERGENCY MEDICINE GUIDE



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- ✦ High quality color photographs
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- ✦ Practice questions based on actual board questions

**PASSING SCORE
GUARANTEED***

By Sajid Khan, MD

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PREFACE

The Model of the Clinical Practice of Emergency Medicine serves as the basis for the content for all ABEM examinations. This document lays the groundwork for the In-training exam, Qualifying exam, and Maintenance of Continuous Certification (ConCert) exam – and now *The Ultimate Emergency Medicine Guide*. By closely examining this document as well as the latest test patterns, we have written this book with a unique approach in mind. Besides trying not to teach you esoteric information that you will likely never see, our approach mixes facts with questions, mnemonics, and high quality color photographs so that information sticks in your mind. It's written in a very practical manner so that the facts are simple to understand and easy to retain.

It features the most up to date information regarding diagnosis and treatment recommendations. With feedback from medical students, residents, and practicing physicians (including recent test-takers), we have no doubt that you will find this book useful. In fact, if you read this book you are *guaranteed* to pass your written boards and recertification exam. To offer your feedback, questions, comments, or if you are interested in contributing to future editions, please contact the author through his website at www.myERdoctor.com.

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PEDIATRICS

- Fractures that are unique to children:
Greenstick fractures are the most common fracture pattern in children. They are an incomplete fracture at the metaphysis-diaphysis junction with one cortex remaining intact.

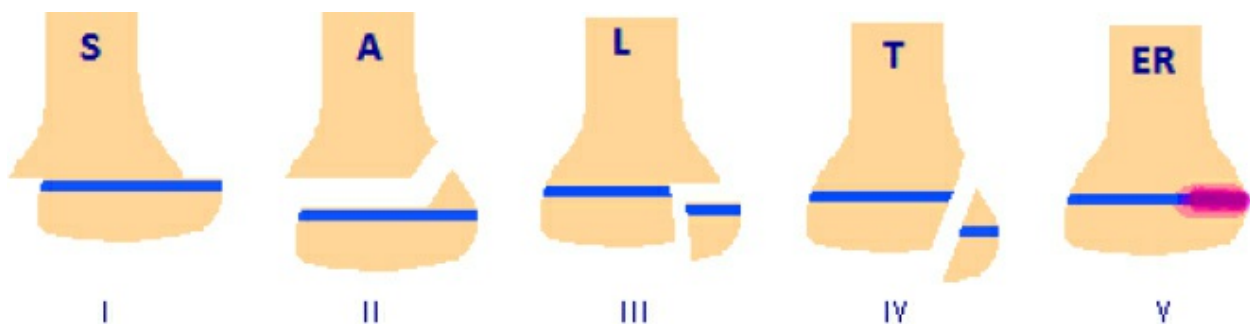


Torus fractures are also called 'buckle' fractures and are also at the metaphysis-diaphysis junction. They are typically the result of compressive forces.



Salter-Harris Fractures

- ▶ Fractures involving the growth plate can lead to growth complications: *don't miss these!*
- ▶ Salter-Harris fractures are frequently seen in the long bones of children
- ▶ An easy mnemonic: **SALTER**



- ◆ Type I = **S**lip (fracture of the physis); may look normal on x-ray
- ◆ Type II = **A**bove (fracture above physis)
- ◆ Type III = **L**ower (fracture below physis)
- ◆ Type IV = **T**hrough (fracture through metaphysis, physis, and epiphysis)
- ◆ Type V = **ER**asing the growth plate – this is the worst type as

disruption of the growth plate causes disruption of growth



A 7 year old child presents after jumping off of a five foot ladder and landing on his feet. He is unable to bear weight due to pain. X-rays of his foot are unremarkable; the ankle is shown below. Which of the following is the most likely diagnosis?



- A) Salter-Harris type 1
- B) Salter-Harris type 2
- C) Salter-Harris type 3
- D) Salter-Harris type 5
- E) None of the above

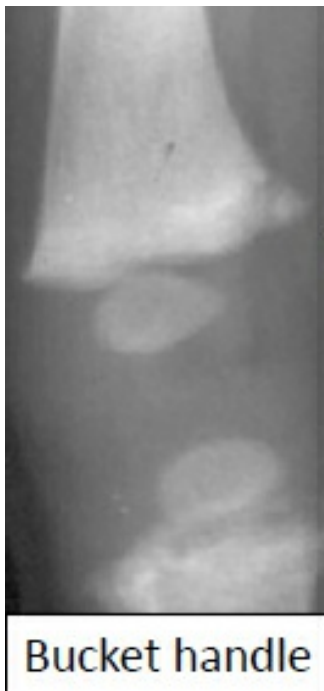
Answer: D

Explanation: X-rays are often negative with type 1 and type 5 injuries. A missed diagnosis of a type 5 fracture carries the worst prognosis as it can prevent further bone growth. Type 5 fractures are rare and typically follow direct axial compression.

- In general, it's more common for children to have an injury to the bone than the ligament. Have a low threshold to obtain imaging studies in children and be wary of routinely diagnosing 'sprains'.
- Child abuse should be considered in any pediatric fracture, in

particular:

- ▶ Bucket handle or 'chip' fracture = epiphyseal fractures from a child being grabbed/shaken; can be bilateral and most involve the tibia or femur
- ▶ Mid-shaft humerus fracture (supracondylar fractures are usually accidental, but mid-shaft fractures require a lot of force)
- ▶ Mid-shaft tibia fracture (distal tibia fractures are less suspicious)
- ▶ Vertebral compression fractures
- ▶ Rib fracture = in particular the lateral and posterior parts of a rib



A skeletal survey is a series of x-rays of most of the major bones of the body and should be done in all cases of suspected child abuse. It consists of: AP views of the arms, forearms, hands, thighs, legs, feet, abdomen, and pelvis; AP and lateral views of the cervical, thoracic, and lumbar spine as well two views of the skull.

HAND

When you think about fingertip infections in the ER, there are three things that should come to mind:

1) Paronychia – infection around the nail fold most commonly caused by *S. aureus*. Besides drainage, treatment typically includes oral antibiotics.



2) Felon – infection of the distal pulp again most commonly caused by *S. aureus*. If left untreated, it can lead to osteomyelitis or tenosynovitis. Most patients require drainage and antibiotics. Drainage of felon: make a lateral fingertip incision (meaning the thumb and fifth finger are incised radially, and others are done on the ulnar side)



3) **Herpetic whitlow** – painful lesion at the fingertip caused by **HSV**. It's typically seen in dishwashers and dental hygienists and unlike the other two, drainage will lead to spread of infection. Put the scalpel away!



- **Boutonniere deformity:** extensor tendon central slip

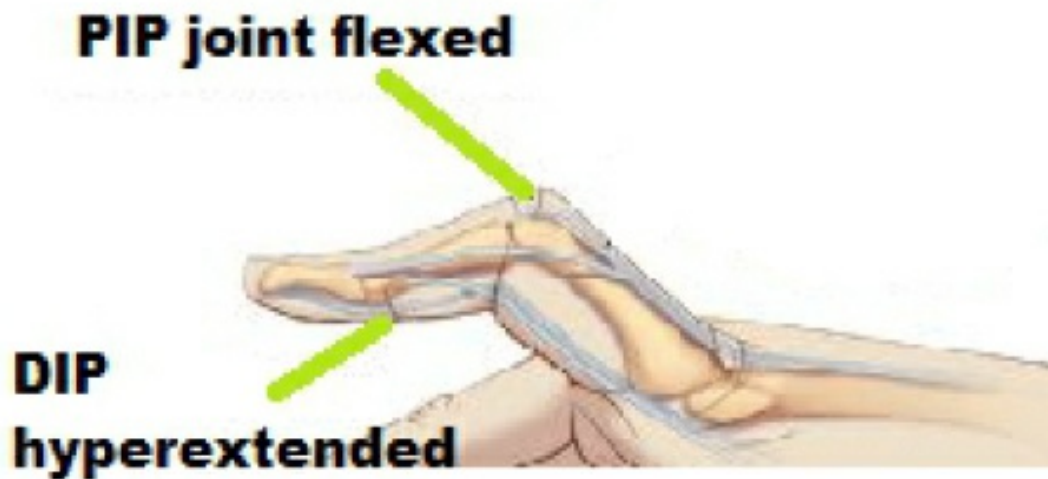
Meaning? The joint is stuck in PIP flexion and DIP hyperextension

Why does it happen? It can be due to an injury (laceration, jammed finger)
or a chronic condition like arthritis

What should I do? Splint the PIP joint in extension

If not treated promptly, the deformity can become permanent (surgery may
be necessary)





- Mallet Finger
 - ▶ Extensor tendon rupture or avulsion fracture at base of distal phalanx
 - ▶ Caused by forced flexion of DIP often from a **direct blow to the tip of the finger (for instance a basketball 'jamming' the fingertip)**
 - ▶ Treatment: splint distal tip in extension



- Jersey Finger
 - ▶ Avulsion of the FDP at the level of the DIP joint (tendon retracts to the level of the PIP and may be palpated on exam)
 - ▶ Frequently involves the ring finger and causes all fingers to

contract as a result

- ▶ Treatment: surgical repair



A bodybuilder presents after dropping a dumbbell on his little pinky finger approximately 36 hours ago. X-rays are negative for fracture. Which of the following is the most appropriate management?



- A) Reassurance and discharge
- B) Trephination
- C) Trephination and antibiotics
- D) Remove the nail, repair any nailbed laceration, and reattach the nail loosely

Answer: B

Explanation: Patients with subungual hematomas *and pain* should undergo trephination for pain relief if the injury is less than 48 hours old. Beyond 48 hours, most hematomas have clotted and trephination is unlikely to be of benefit. Of note, small nailbed lacerations with an intact nail are *not* an indication for nail removal.

An 18 year old male presents to the ER with pain in his right thumb. He was playing football and the ball came in faster than he expected – when he went up for the catch it bent his thumb back. He now has difficulty pinching his thumb and index fingers together. Which of the following is most likely injured?

- A) Flexor digitorum superficialis
- B) Radial collateral ligament
- C) Ulnar collateral ligament
- D) Extensor tendon
- E) Median nerve

Answer: C

Explanation: This patient likely has ‘gamekeeper’s thumb’, also known as ‘skier’s thumb’. The hallmark symptom is weakness of the pincer grasp. If the ulnar collateral ligament is completely torn, surgery may be required and Stener lesions may develop. If partially torn, the ligament may heal with rest and a thumb spica **splint**. Gamekeeper’s thumbs are often associated with avulsion fractures at the base of the thumb as well.

Gamekeeper’s thumb: > 30° joint laxity when radial stress is applied to the thumb MCP

- Metacarpal Fractures
 - ▶ Metacarpal neck fractures warrant reduction if angulation is more than:
 - ◆ 10 degrees in index or middle finger
 - ◆ 20 degrees in ring finger

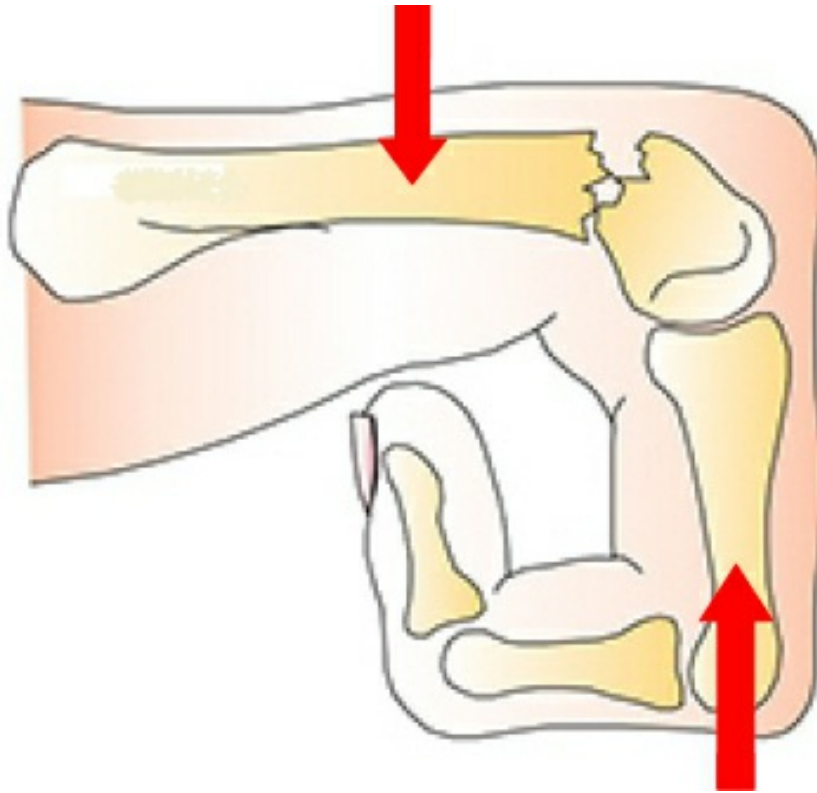
- ◆ 40 degrees in small finger
- ▶ Boxer's fracture = fracture of the neck of the 5th metacarpal
- ▶ Always assess metacarpal neck fractures for rotational deformity



Have the patient make a fist and see if the fingers cross – if the fingers overlap at all, this ‘rotational deformity’ should be corrected as it can lead to real disability



How does one reduce a metacarpal neck fracture?



After appropriate anesthesia, place the finger parallel to the floor. The MCP joint should be flexed to 90 degrees so that the finger is pointing downwards. Put downward pressure on the metacarpal shaft while applying upward pressure to the phalange.

Open metacarpal fractures do not necessarily *require* that the patient make a stat trip to the OR for irrigation/washout. If there is no evidence of gross contamination, it may be reasonable to perform a good thorough bedside irrigation and discharge the patient home with antibiotics and close follow-up. This is different from the way long bone fractures are managed: an open long bone fracture traditionally needs urgent washout.

Be familiar with the difference between a Bennet's Fracture and a Rolando Fracture:

- Bennet's Fracture
 - ▶ Fracture at base of 1st metacarpal
 - ▶ Intra-articular



- Rolando Fracture
 - ▶ Fracture at base of 1st metacarpal
 - ▶ Comminuted intra-articular



Fight bite: when a fist strikes teeth, the guy with that fist needs antibiotics. If he has a fracture he probably needs IV antibiotics for an open fracture. Fight bites are **highly prone to infection** since the extensor tendon and MCP joints are relatively avascular and therefore have limited ability to combat infection. The **3rd MCP joint of the dominant hand** is most often affected. If left untreated, these can lead to **tenosynovitis**.

Ever wish there were some criteria to identify who might have

tenosynovitis? Thankfully, Dr. Kanavel felt the same way:

- **Kanavel's signs for flexor tenosynovitis**
 - ▶ Fusiform swelling, 'sausage digit'
 - ▶ Finger stuck in flexed position
 - ▶ Pain with extension (earliest sign)
 - ▶ Tenderness along the flexor tendon
- High Pressure Injection Injury (for instance a paint gun injection into the hand) – don't fall asleep on these! They may appear benign early but can rapidly lead to compartment syndrome or ischemia. Get an x-ray, start antibiotics, and **call the orthopedist**
Boards likes to ask for the 'next best step' even when you would do multiple things at once. If given the choice, consult orthopedic surgery first.
- What to do if someone accidentally injects an epi-pen into their fingertip?
 - ◆ Apply topical nitroglycerin paste to the affected area, place a glove over the paste, and place the hand in warm water (vasodilation)
 - ◆ If still painful, inject phentolamine locally. Some sources say to go straight to the phentolamine so if you see a question about this, phentolamine is probably the answer they're looking for.

WRIST

- **Colles Fracture**
 - ▶ Most common fracture in adults age > 50
 - ▶ Distal radius fracture with dorsal displacement
 - ▶ Frequently associated with an ulnar styloid fracture

- ▶ Important to assess median nerve for injury
- ▶ Treatment: closed reduction



- Smith Fracture
 - ▶ ‘Reverse Colles’
 - ▶ Distal radius fracture with volar displacement
 - ▶ Treatment: closed reduction



- Barton's Fracture
 - ▶ Distal radius fracture with dislocation of radiocarpal joint
 - ▶ Most common fracture-dislocation of the wrist
 - ▶ Most will require external fixation/surgical treatment



A 50 year old woman was chasing her cat and tripped over another cat. She fell onto an outstretched hand to avoid landing on a third cat. The fourth cat called 911 and she is now in your ER. She has anatomic snuffbox tenderness and x-rays are unremarkable. Which of the following is most appropriate?

- A) Discharge home with reassurance
- B) If the patient still has pain, recommend an MRI to evaluate for ligamentous injury
- C) Consult orthopedic surgery
- D) Splint the patient and have them follow up

Answer: D

Explanation: The scaphoid is the most frequently fractured carpal bone, but it is prone to not healing well due to its unique blood supply. Blood supply to the bone is from **distal to proximal** – since most fractures occur in the

middle 1/3rd of the scaphoid, many fractures are prone to avascular necrosis. This is why even patients with negative x-rays but *suspicion* for scaphoid fracture should have a thumb spica splint placed and outpatient follow-up.

Most people already know that the scaphoid is the most frequently fractured carpal bone.

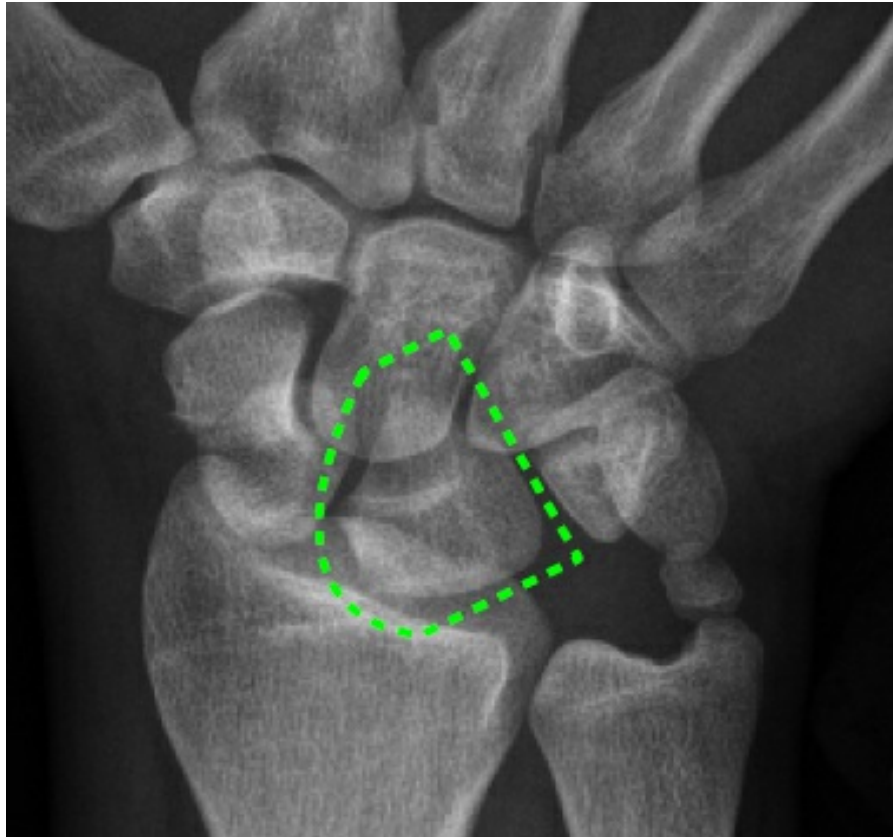
Did you know the triquetrum is the second most frequently fractured?

- Scapholunate Dissociation
 - ▶ *Most common ligamentous injury of the hand*
 - ▶ > 3 mm separation is suggestive of scapholunate dissociation
 - ▶ > 5 mm separation between scaphoid and lunate confirms the diagnosis
 - ▶ Treatment: thumb spica splint, orthopedic referral for operative repair



- A frequently seen and frequently missed distinction is that of a lunate from a perilunate dislocation:
 - ▶ Lunate Dislocation: lunate is displaced but the capitate is still aligned
 - ▶ Perilunate Dislocation: lunate is aligned but all other

carpal bones are displaced



Perilunate dislocations classically have a 'pie-shaped' lunate on the AP view.

But the real diagnosis is made on the lateral film...



In the first image the lunate itself is dislocated anteriorly. In the second image, all the bones around the lunate (PERI-lunate) are dislocated posteriorly

- Carpal Tunnel Syndrome
 - ▶ **Entrapment of the median nerve**
 - ▶ Risk factors: pregnancy, diabetes, hypothyroidism, rheumatoid arthritis Phalen's sign = hyperflexion of both wrists → paresthesias in median nn Tinel's sign = tapping volar wrist → paresthesias in median nn
 - ▶ Both Phalen's and Tinel's have poor sensitivity and specificity.
 - ▶ **Most sensitive finding: abnormal sensation of the distal tip of the index finger**
 - ▶ In general, sensory findings present much earlier than motor ones

- ▶ Treatment: splint, NSAIDs, steroid injections, surgery
- Guyon's Canal Syndrome
 - ▶ Guyon's canal is formed by a ligament connecting the pisiform to the hamate and **contains the ulnar nerve**
 - ▶ Symptoms: *numbness/tingling in ulnar distribution*
 - ▶ Caused by repetitive trauma (bicyclists holding handlebars, players holding golf clubs or baseball bats)
 - ▶ Treatment: splint, surgery for decompression
- DeQuervain's Tenosynovitis
 - ▶ Overuse of the extensor pollicis brevis and the abductor pollicis longus
 - ▶ Finkelstein's test = ulnar deviation of fist reproduces pain
 - ▶ Treatment: splint, NSAIDs



A well-known alcoholic patient presents to the ER with wrist drop. He says he was out celebrating last night because it was his birthday. So what do you think happened? He probably partied a little too hard and passed out while sleeping on his arm all night – compressing his radial nerve. Prognosis? It can take days to years for the wrist drop to resolve depending on the extent of the compression. Treatment is to splint the wrist in extension.

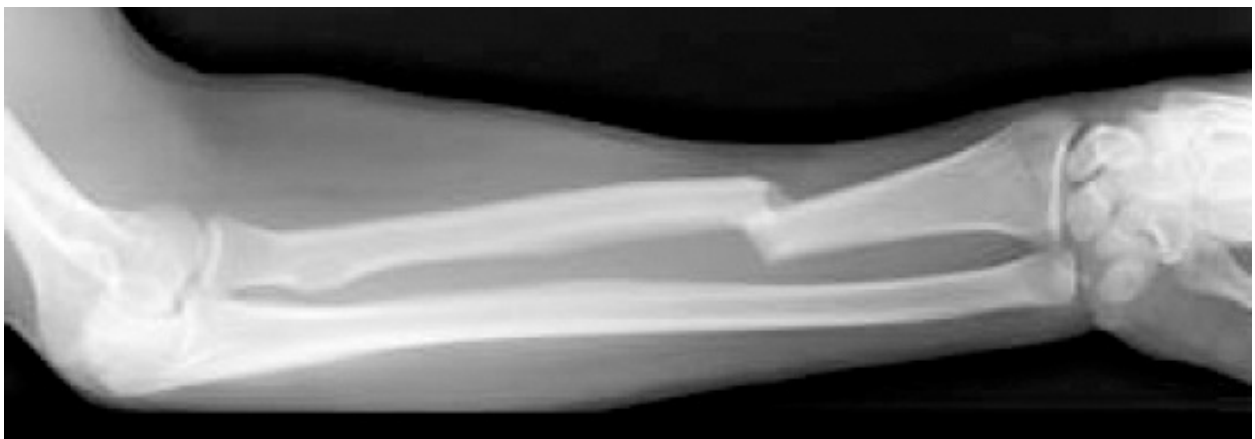
FOREARM

Make sure you can distinguish a Monteggia from a Galeazzi fracture.
There are a lot of mnemonics available but one of the more popular ones is MUGR: Monteggia ulna Galeazzi radius.

Monteggia Fracture: **Ulnar fracture, radial head dislocation**; important to assess **radial** nerve



Galeazzi Fracture: **Radius fracture, distal radioulnar joint dislocation**; important to assess **ulnar** nerve



A costume-wearing superhero presents to the ER. He was attacked by a costume-wearing supervillain who was wielding a baseball bat. Our hero put his arms up to block the blows – he managed to defeat the villain and save a school full of children, but his arm *really* hurts. X-rays reveal an ulnar shaft fracture. Which of the following nerves is most likely to be involved?

- A) Radial nerve
- B) Ulnar nerve
- C) Median nerve
- D) Musculocutaneous nerve

Answer: A

Explanation: “Nightstick fracture” refers to a nondisplaced ulnar shaft fracture. The most important nerve to assess is the radial nerve. Median nerve injuries may also occur but ulnar nerve involvement in forearm fractures is extremely rare.

- Volkmann’s Contracture
 - ▶ Can result from inadequate circulation to the forearm (caused by tight casts or swelling from forearm fractures)
 - ▶ Results in forearm pronation, wrist flexion, and paralysis of intrinsic muscles
 - ▶ Irreversible damage if the duration is > 6 hours



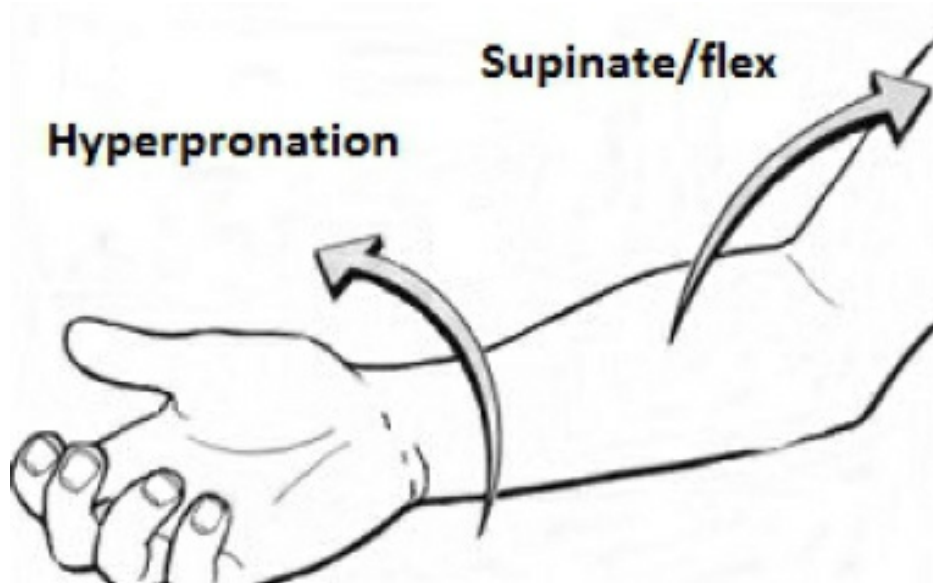
ELBOW

- Anterior fat pad can be normal
- Posterior fat pad is never normal (sign of occult radial head fracture in adults, supracondylar fracture in children)



- Radial Head Fracture

- ▶ Typically seen after a fall on outstretched hand (FOOSH)
- ▶ Treatment: most do not require surgery
- Lateral Epicondylitis (tennis elbow) is the most common overuse injury of the elbow. Treatment is rest and NSAIDs. Medial Epicondylitis (seen in pitchers and golfers) is treated the same.
- Olecranon Bursitis
 - ▶ Produced by repetitive minor trauma (leaning on elbows for instance)
 - ▶ **Septic bursitis**
 - ▶ Complicates up to 1/3rd of bursitis cases
 - ▶ Occurs almost exclusively in olecranon or prepatellar bursae
 - ▶ Most common organism causing septic bursitis: *S. aureus*
 - ▶ Diagnosis: aspiration with fluid showing > 10,000 WBC
 - ▶ Treatment: conservative, consider aspiration
- **Nursemaid's Elbow**
 - ▶ Found in children who are pulled or swung by the arm
 - ▶ The child is reluctant to move the arm (held flexed and pronated)
 - ▶ Anatomical defect: **subluxation of the radial head**
 - ▶ X-rays are unnecessary and would be normal
 - ▶ Treatment: supinate the forearm and flex the elbow OR hyperpronation

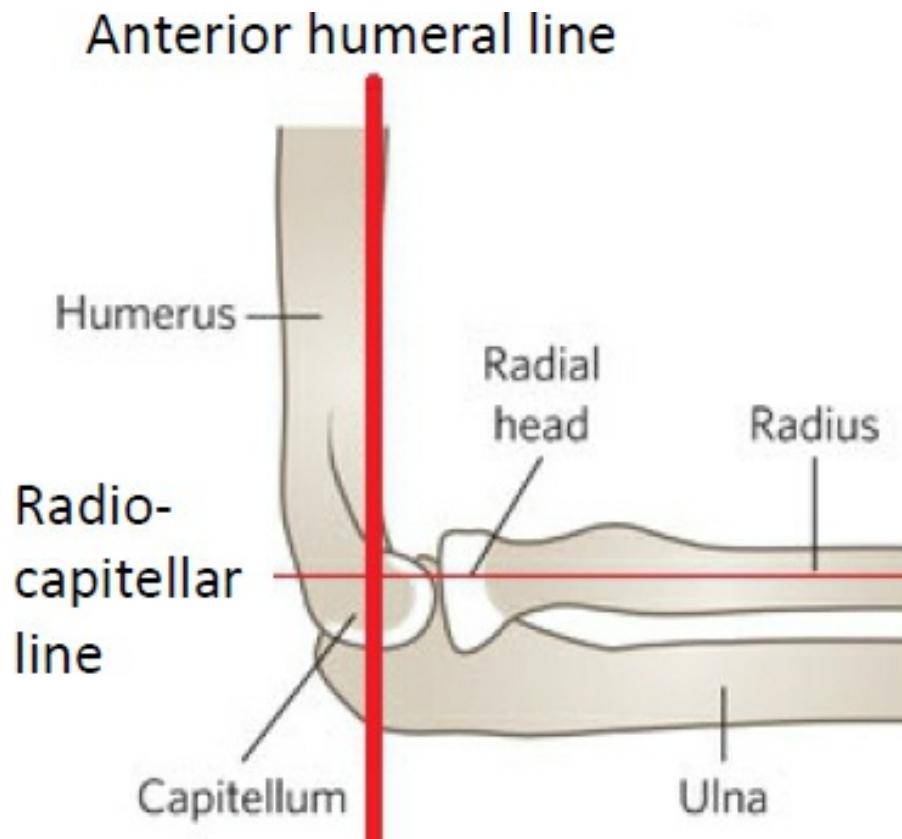


- Elbow Dislocation
 - ▶ Posterior dislocations are more common
 - ▶ Important to assess brachial artery and ulnar nerve
 - ▶ Treatment: closed reduction
 - ▶ Always remember to reassess neurovascular status after reduction



- Supracondylar Fracture
 - ▶ Seen most often in children; the only clue may be the presence of a posterior fat pad

- ▶ Important to assess brachial artery and median nerve
- ▶ Displaced fractures may require hospitalization for neurovascular checks
- ▶ The anterior humeral line should bisect the middle third of the capitellum and can be used to identify occult supracondylar fractures



SHOULDER

Which type of shoulder dislocation is more common?

About 95% are anterior and only 5% are posterior

Posterior dislocations are classically associated with electrical injuries and seizures

If you notice a dislocation on x-ray, what else should you look for?

Humeral head fracture aka Hill-Sachs deformity (the more common of the two) Glenoid rim fracture aka Bankart's lesion

How are anterior from posterior dislocations distinguished clinically?

Anterior: the arm is held in abduction and external rotation

Posterior: the arm is held in adduction and internal rotation

In posterior dislocation, the humeral head is internally rotated and looks like a lightbulb on the AP view



What is an inferior dislocation?

Also known as 'luxatio erecta', these are extremely rare

The forearm is **locked overhead from forceful hyperabduction**

There is a high complication rate; inferior dislocations are associated with severe rotator cuff injuries and neurovascular compromise



- Rotator Cuff
 - ▶ Muscles: Supraspinatus, Infraspinatus, Teres Minor, Subscapularis
 - ▶ Acute tears produce a tearing sensation in the shoulder and poorly localized pain radiating to the arm
 - ▶ Can occur after a fall onto an outstretched arm or in association with shoulder dislocations
 - ▶ Treatment: sling and refer to orthopedics for possible surgical repair

A patient suffers a closed clavicle fracture. Which of the following is an indication for referral to orthopedic surgery?









- A) Fracture of the medial 1/3rd of the clavicle
- B) Fracture of the distal 1/3rd of the clavicle
- C) Skin tenting without an open wound over the clavicle
- D) Associated pneumothorax

Answer: C

Explanation: Most clavicle fractures involve the middle 1/3rd and are treated conservatively with a sling. Indications for referral include displaced fractures, evidence of neurovascular compromise, and skin tenting (which can imply significant displacement and possible impending open fracture). Anyone who receives a shoulder sling should be given instructions for early range of motion exercises. This can help prevent adhesive capsulitis ('frozen

shoulder').

- Sternoclavicular Dislocation
 - ▶ Anterior dislocation more common than posterior and results from medially directed force to the shoulder
 - ▶ Anterior dislocations are not associated with serious injuries
 - ▶ Posterior dislocations may cause airway or mediastinal injuries
- Humerus Fracture
 - ▶ Proximal fracture – assess axillary nerve
 - ▶ Midshaft fracture – assess radial nerve
 - ▶ **Neer classification** according to the amount of displacement in four segments: anatomic neck, surgical neck, greater / lesser tuberosity
 - ◆ One-part fracture = none/minimal displacement
 - ◆ Two-part fracture = displacement of one fragment
 - ◆ Three-part fracture = two individual fragments separate from humerus
 - ◆ Four-part fracture = displacement of all four segments

	2 part	3 part	4 part
Anatomic Neck			
Surgical Neck			
Greater Tuberosity			
Lesser Tuberosity			

- Thoracic outlet syndrome: compression of the brachial plexus and/or subclavian vein when the space between the clavicle and first rib (the

‘thoracic outlet’) is narrowed. There are three main variants: neurogenic, venous, and arterial; symptoms will depend on which of these is affected.

PELVIS AND HIP

3 things to keep in mind for pelvic fractures:

If the pelvis is unstable, wrap with a bedsheet or other compressive device

Treat hypotension aggressively with transfusion

Do *not* place a foley if urethral injury is suspected

When should you suspect a urethral injury? If any of these three conditions exist:

1 – Blood at the urethral meatus

2 – High-riding prostate

3 – Scrotal hematoma

The patient will need a retrograde urethrogram to assess the status of the urethra. If retrograde urethrogram is normal but the patient has gross hematuria, the next step is to obtain a cystoscopy (more on this in the Trauma chapter).

- Open-book Fracture
 - ▶ Widened pubic symphysis
 - ▶ Typically results from an anteroposterior compression (crush) injury
 - ▶ Treatment: angiography with embolization and surgical fixation



ER management: place a pelvic binder at the level of the greater trochanters

- Bimanual pelvic exam should be performed on women with pelvic injuries – if blood is found, a speculum exam should be done
- Hip Fracture
 - ▶ Leg is externally rotated and shortened
 - ▶ Femoral neck fractures have a high incidence of avascular necrosis
 - ▶ Lesser trochanter fractures are most common in young adults due to forceful contraction of the iliopsoas (they can ambulate but can't lift leg from the floor while in a seated position)
- Hip Dislocation
 - ▶ Leg is internally rotated and shortened (in most cases)
 - ▶ Posterior type is most common (mechanism: knee vs dashboard)
 - ▶ There is a high incidence of avascular necrosis directly associated with duration of dislocation
 - ▶ **Avascular necrosis is frequently missed on plain films – an MRI is the test of choice**
 - ▶ Always assess the sciatic nerve (dorsiflexion)
- Femur Fracture

- ▶ Traction can be used for a femoral *shaft* fracture but is contraindicated with a femoral *neck* fracture
 - ▶ Traction splints reduce muscle spasm, help prevent further injury to nerves/vessels, and reduce pain
 - ▶ Treatment: generally requires ORIF
 - ▶ After a closed long bone fracture, fat emboli can enter the circulation. 'Fat embolism syndrome' is a serious manifestation of fat emboli: hypoxia, pulmonary edema, CNS depression, and petechiae.
- Slipped Capital Femoral Epiphysis (SCFE)
 - ▶ Most often seen in obese adolescent males
 - ▶ Can be bilateral!
 - ▶ Diagnosis: X-ray (frog leg view)
 - ▶ Treatment: ORIF



- Transient Synovitis
 - ▶ Most common cause of painful hip in children
 - ▶ Associated with recent viral infection, trauma, or vaccination
 - ▶ **Important to rule out septic arthritis! (check CBC, ESR, CRP)**
 - ▶ Patients *may* have a low grade fever and increased ESR
 - ▶ Treatment: NSAIDs
- Septic Arthritis

- ▶ *S. aureus* is the most common organism isolated overall
 - ▶ In patients < 30 years of age, *N. gonorrhoeae* is more common
 - ▶ Most joints become infected by hematogenous spread rather than direct inoculation
 - ▶ Diagnosis: needle aspiration, frequently done under IR guidance
- Legg-Calve-Perthes Disease
 - ▶ Avascular necrosis of the femoral head
 - ▶ Pain and limp are early signs
 - ▶ Seen in younger children, typically age 4-6 years
 - ▶ X-rays can be negative (ultimate diagnosis: MRI or bone scan)



KNEE

What is the ‘unhappy triad’?

No, this doesn’t refer to your three years of emergency medicine residency... we’re talking about the ACL, MCL, and medial meniscus! This type of injury often occurs when a lateral force is applied to the knee while the foot is planted.

- Meniscal tear causes clicking, catching, or locking of joint during motion of the knee. The largest of all meniscus tears is a ‘bucket

handle' tear; often associated with ACL tears, it is unstable and will cause ongoing discomfort.

- Osgood-Schlatter Disease
 - ▶ Focal anterior knee pain at the **tibial tuberosity**; can be bilateral
 - ▶ **Exclusive to those age 19 years and younger** (growth plates still active) Treatment: NSAIDs, rest (self-limited)

What is the difference between a *patellar* dislocation and a *knee* dislocation? One will get you a knee immobilizer and ibuprofen, while the other will get you an excited orthopedic surgeon and your anesthetic of choice.

- Patellar Dislocation
 - ▶ Almost always dislocated laterally; reduce with extending the knee and manually displacing the patella medially
 - ▶ Frequently recur

Use medial force to reduce laterally displaced patella



- Knee Dislocation
 - ▶ High-energy injury
 - ▶ Often reduces spontaneously but you must **consult an orthopedic surgeon emergently**
 - ▶ Important to assess **popliteal artery and peroneal nerve**
 - ▶ Almost all cases should have an arteriogram and vascular surgery consult given the high concern for arterial injury

- **Ottawa Knee Criteria** – used to help determine when to obtain x-rays
 - ▶ Age > 55
 - ▶ Isolated tenderness of patella
 - ▶ Tenderness at head of fibula
 - ▶ Inability to flex the knee 90 degrees
 - ▶ Inability to bear weight both immediately and in the ER
- Bakers Cyst
 - ▶ Swelling in popliteal fossa due to enlargement of gastrocnemius bursa
 - ▶ Can rupture leading to acute onset of severe pain that looks and feels like a DVT (erythema, warmth, tenderness in calf). While the diagnosis is clinical, an ultrasound is frequently done to rule out DVT.

Be able to differentiate between a quadriceps tendon rupture and a patellar tendon rupture – both clinically and by imaging:

Patients who suffer quadriceps tendon ruptures tend to be older; x-ray can show a low-riding patella



Patients who suffer patellar tendon ruptures tend to be younger athletes; x-ray can show a high-riding patella



- Tibial Plateau Fracture
 - ▶ Most involve the lateral plateau
 - ▶ Important to assess the deep peroneal nerve
 - ▶ Treatment: ORIF

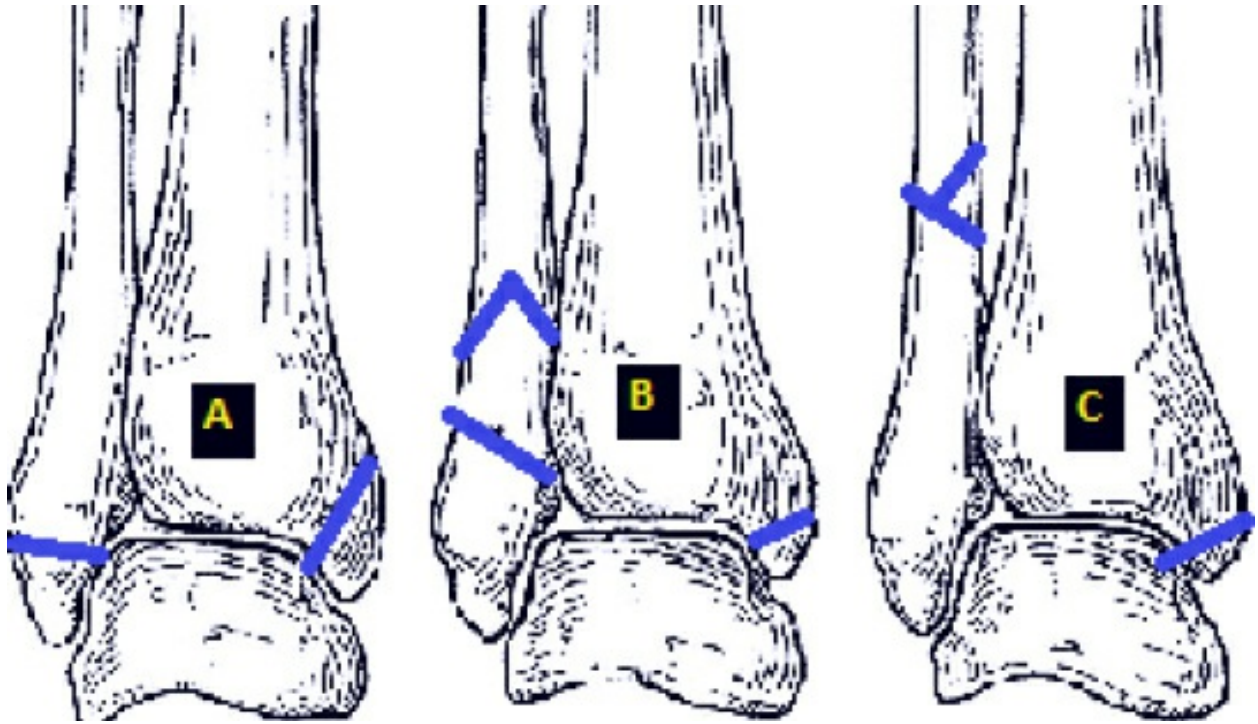


- Compartment Syndrome
 - ▶ Can occur with fractures (*even with open fractures!*), crush/high pressure injection injuries, tight casts, burns, snake bites, etc.
 - ▶ Seen most often with tibial and forearm fractures
 - ▶ 6 P's
 - ◆ Pain (earliest sign)
 - ◆ Pallor
 - ◆ Paresthesias
 - ◆ Paralysis
 - ◆ Poikilothermia
 - ◆ Pulselessness (late sign)
 - ▶ **Diagnosis: CLINICAL**
 - ▶ Treatment: fasciotomy. Most recommendations are fasciotomy for pressure > 30mmHg. Depending on the perfusion pressure, higher compartment pressures may be tolerated. Therefore, the 'delta pressure' can be used and refers to the difference between the diastolic blood pressure and the compartment pressure; < 30mmHg is concerning.
- Meralgia Paresthetica
 - ▶ Lateral femoral cutaneous nerve compression
 - ▶ Seen more often in pregnant women
 - ▶ Symptoms: lateral thigh burning-type pain

ANKLE/FOOT

- Achilles Tendon Rupture
 - ▶ Frequently results from sudden acceleration like when jumping
 - ▶ Can also be a side effect of ciprofloxacin use
 - ▶ Middle aged men ('weekend warriors')
 - ▶ Symptoms: feeling a 'pop', sudden pain in back of ankle
 - ▶ Many patients will have a palpable defect

- ▶ Thompson test = failure to plantar flex with calf compression
- ▶ Treatment: splint in equine position with gradual dorsiflexion to a more neutral position; some patients will need operative repair
- Gastrocnemius Rupture
 - ▶ Associated with sudden changes in direction (seen in tennis players)
 - ▶ Negative Thompson test
- Most ankle sprains involve the *anterior talofibular ligament*
- Weber Classification of Lateral Malleolus Fractures
 - ▶ Weber A
 - ◆ Below the ankle joint
 - ◆ Medial malleolus frequently also fractured; deltoid ligament intact
 - ◆ Treatment: stable, most require ORIF
 - ▶ Weber B
 - ◆ At the ankle joint
 - ◆ Medial malleolus may be fractured; deltoid may be ruptured
 - ◆ Variable stability
 - ▶ Weber C
 - ◆ Above the ankle joint
 - ◆ Medial malleolus fractured; deltoid ligament injured
 - ◆ Treatment: unstable, requires ORIF



- Trimalleolar fracture
- A fracture involving the lateral and medial malleolus, as well as the posterior distal tibia (aka 'posterior malleolus'): ORIF is generally required



- Maisonneuve Fracture
 - ▶ Eversion injury leading to proximal fibula + medial malleolus fracture
 - ▶ This is why it's a good reason to squeeze the calf of any patient with an ankle fracture – if there is tenderness, get a tib/fib x-ray
 - ▶ Treatment: goal is to maintain a normal ankle mortise; usually splinting is enough but if the syndesmosis needs realignment, ORIF may be needed



- Pilon Fracture
 - ▶ Aka 'pilon fracture'
 - ▶ Comminuted distal tibia fracture from strong axial force driving the talus onto the tibial plafond (fall from height for instance)
 - ▶ Many associated injuries (fracture of fibula, calcaneus, vertebral body, pelvis)
 - ▶ Causes severe soft tissue swelling
 - ▶ Treatment: most require surgery
 - ▶ Post-traumatic arthritis is a common complication



- Calcaneus Fracture
 - ▶ Most common tarsal bone fracture
 - ▶ Typically occurs after a fall (“I fell off a ladder and landed on my feet...”)
 - ▶ **Always check for associated lumbosacral fractures**
 - ▶ X-ray findings: bohler’s angle < 20 degrees

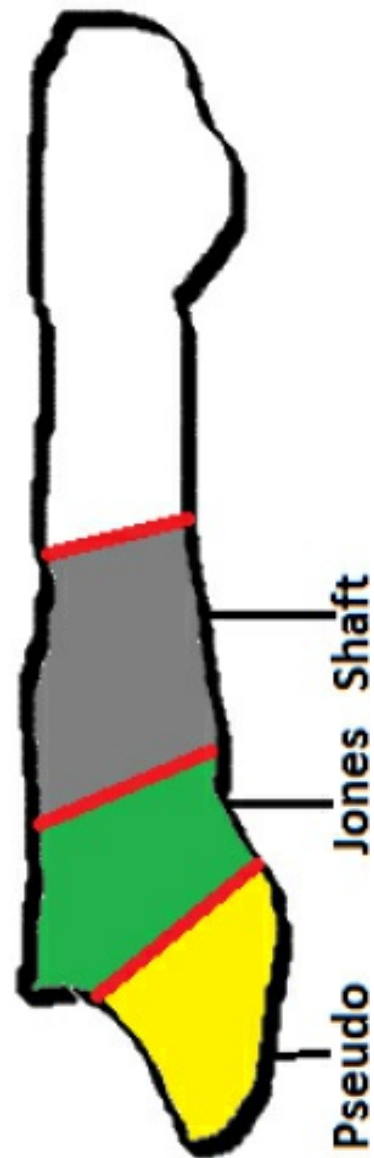
A young female presents to the ER after twisting her foot while going down the stairs. X-rays are done – what is the most appropriate way to manage this injury?



- A) Contact orthopedic surgery for possible operative repair
- B) Discharge home with a hard soled shoe
- C) Discharge home with a cast
- D) Closed reduction and splint placement in the ER

Answer: A

Explanation: This patient has a 'Jones' fracture, which is at high-risk for complications if left untreated. After consultation with orthopedics, the patient may be discharged home with a splint and instructions to remain non-weight-bearing. However, many of these fractures will require operative repair. It's important to distinguish a 'Jones' from 'Pseudojones' from metatarsal shaft fracture.



The first step is to measure from the distal tip of the fifth metatarsal to the fracture site (indicated by the red line below) – if this number is greater than 15mm, then it's a metatarsal shaft fracture. If the number is less than 15mm, it's either a 'Jones' or 'Pseudojones' fracture. Pseudojones fractures are simple avulsion fractures that can be treated with a hard soled shoe and weight bearing as tolerated.



Lisfranc Fracture: A patient falls and has her foot fold under her. She has pain to her midfoot but initial x-rays are normal. What now? Keep in mind that the Lisfranc joint is one that's formed by the base of the 1st and 2nd metatarsals & the cuneiforms. If the joint is disrupted, initial x-rays are often normal so weightbearing films can be of benefit. Missed or delayed diagnosis can have significant consequences. Most Lisfranc injuries will require ORIF.



An intra-articular fracture of the base of the 2nd metatarsal with widening of

the space between the 1st and 2nd metatarsals is suggestive of a Lisfranc injury

- Tarsal Tunnel Syndrome
 - ▶ Entrapment neuropathy involving posterior tibial nerve
 - ▶ Nocturnal pain is common
 - ▶ Tinel's sign = tapping on nerve → paresthesias
- Morton's Neuroma
 - ▶ Benign neuroma of an intermetatarsal plantar nerve
 - ▶ Pain and numbness that is relieved by removing shoes
- Plantar Fasciitis
 - ▶ Inflammation of plantar fascia on sole of foot from overuse
 - ▶ Pain is most intense with the first steps of the day
 - ▶ Treatment: rest, NSAIDs

SPINE

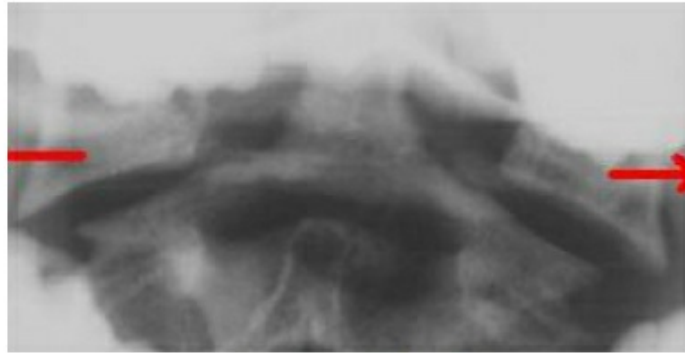
- **NEXUS criteria** can help guide decision-making after blunt trauma to the C- spine. Patients who have any of the following may warrant imaging (**NSAID**):
 - ◆ Neurologic deficit
 - ◆ Spinal midline tenderness
 - ◆ Alertness not present (disoriented)
 - ◆ Intoxication
 - ◆ Distracting injury

**** In general, if one spinal fracture is noted, the entire spine should be imaged ****

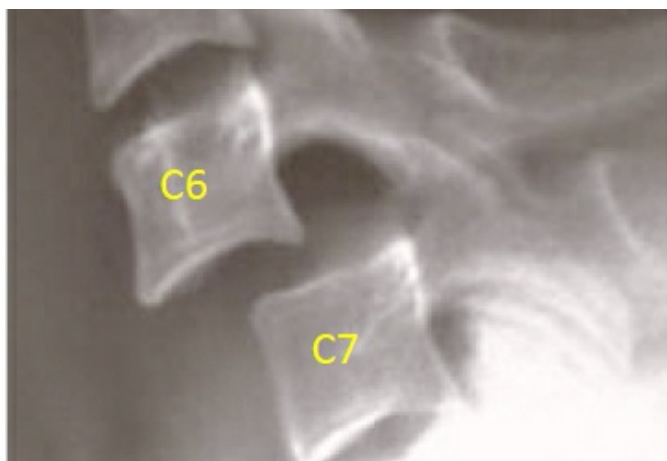
- Which C-spine injuries are considered 'unstable'? Use the mnemonic:

Jefferson Bit Off A Hangmans Thumb

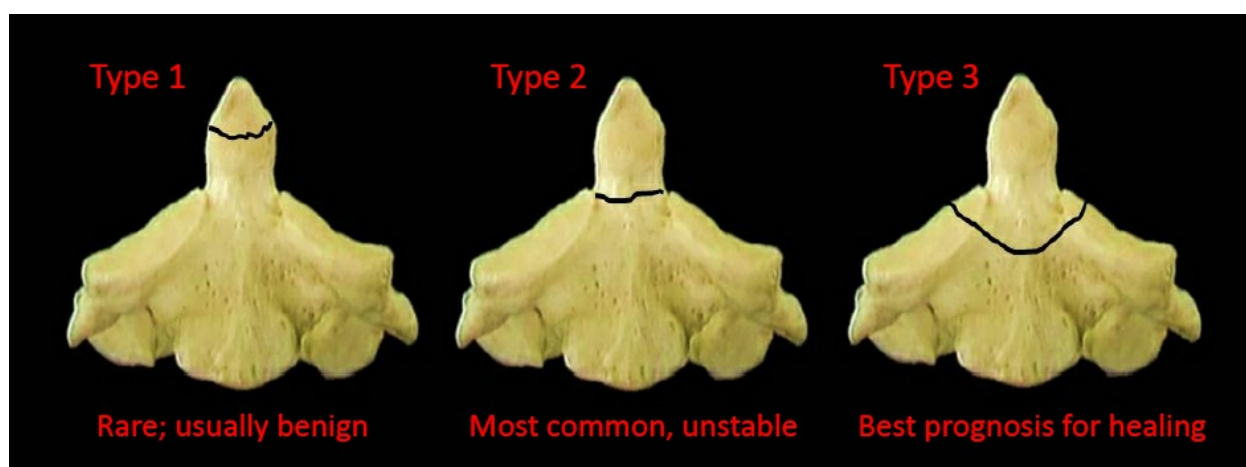
- ▶ **Jefferson's fracture:** unstable burst fracture of C1 from axial compression



- ▶ **Bilateral cervical facet dislocation**
 - ◆ C6 facets lie anterior to those of C7 with resulting subluxation of the vertebral body



► **O**dontoid



- **A**tlanto-occipital dissociation
- **H**angmans fracture: unstable hyperextension fracture of C2 pedicles



- ▶ **T**eardrop fracture: generally considered the *most* severe as they frequently cause anterior cord syndrome and quadriplegia. They typically occur from severe flexion and compression at C5/6 (for instance diving into a pool head-first)



- Clay Shoveler's fracture is another eponymous spinal fracture to be aware of. It is a stable fracture of the spinous process of the lower cervical vertebra. Many are missed initially and incidentally seen years later.



A child presents to the ER after a motor vehicle accident with neck pain and numbness going down his left arm. Grip strength is 3/5 on the affected side. CT scan of the cervical spine is unremarkable. Which of the following is the next best step?

- A) Discharge home with a rigid collar and close follow-up
- B) Obtain flexion/extension views of the cervical spine
- C) Order an MRI of the cervical spine
- D) Administer steroids and obtain a neurosurgery consultation

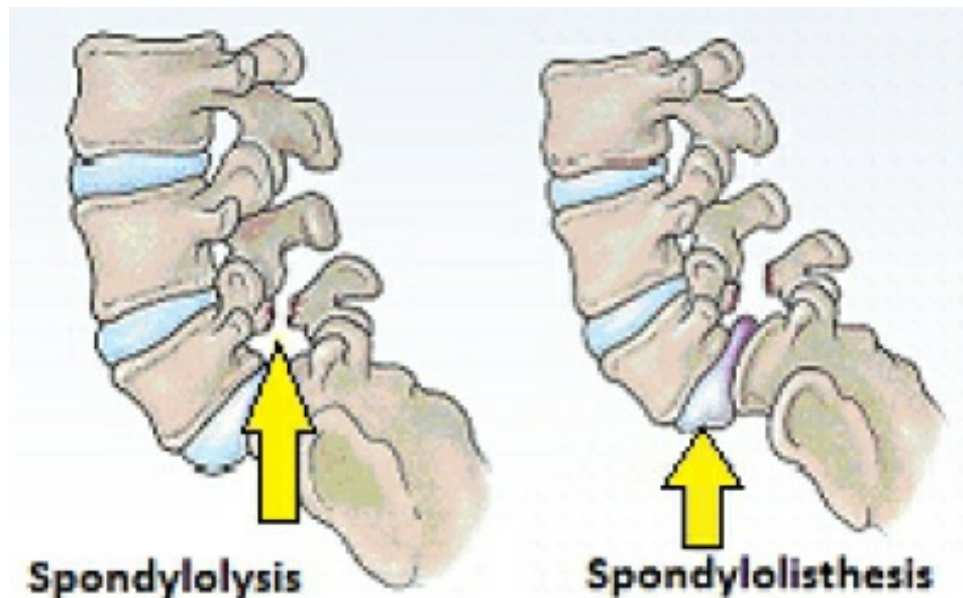
Answer: C

Explanation: Children may suffer an injury known as SCIWORA, or 'spinal cord injury without radiographic abnormality'. It classically affects the cervical spine and is characterized by neurologic deficits in a patient with neck pain. Plain films and CT scan are often normal and an MRI is necessary to make the diagnosis.

The term '**sciatica**' refers to pain, tingling, weakness, or numbness along the

sciatic nerve (starting in the lower back and radiating down one leg). It's actually a symptom rather than a diagnosis, and there are a variety of underlying causes:

- **Spondylolysis** = Defect in pars interarticularis; technically a fracture that is usually the result of repetitive microtrauma (a 'stress fracture')
- **Spondylolisthesis** = same defect + anterior displacement of vertebra



- **Spinal Stenosis**
 - ▶ L5 is most commonly involved
 - ▶ Treatment: NSAIDs, physical therapy, steroid shots, surgery as last resort
- **Piriformis Syndrome**
 - ▶ Sciatica results from irritation or compression of the sciatic nerve by the piriformis muscle – this can occur from repetitive microtrauma or prolonged sitting on a hard surface
- **Straight leg raise (SLR)** has **good sensitivity but poor specificity**. **'Crossed' SLR**, on the other hand, where the unaffected leg is raised and elicits radicular pain, is almost pathognomonic (**very high specificity**). If pain is elicited when the leg is raised between 30 and 70

degrees, consider **herniated disk** with nerve root compression. If pain arises at less than 30 degrees, consider **abscess**, **tumor**, or spondylolisthesis.

SLR is considered positive only if the patient complains of radicular pain radiating down the leg PAST the knee

NERVE INJURY REVIEW

Humeral Shaft Fracture	Radial
Proximal Humerus Fracture	Axillary
Shoulder Dislocation	Axillary
Monteggia	Radial
Galeazzi	Ulnar
Supracondylar Fracture	Median
Elbow Dislocation	Ulnar
Colles/Smith Fracture	Median
Acetabular Fracture	Sciatic
Anterior Hip Dislocation	Femoral
Posterior Hip Dislocation	Sciatic
Femoral Shaft Fracture	Peroneal
Knee Dislocation	Peroneal
Tibial Plateau Fracture	Deep Peroneal
Sacral Fracture	Cauda Equina



ACUTE CORONARY SYNDROME (ACS)

Unstable angina occurs suddenly and often at rest

vs

Stable angina which develops during activity and resolves with rest

- **Prinzmetal's Angina**
 - ▶ Coronary artery vasospasm
 - ▶ Occurs at rest; can improve or worsen with exercise so exercise stress testing has limited value
 - ▶ Patients may or may not have underlying coronary artery disease
 - ▶ EKG: ST elevation that cannot be distinguished from acute MI
 - ▶ Labs: **Normal troponin** level
 - ▶ Treatment: nitrates to treat vasospasm
- **NSTEMI vs STEMI**
 - ▶ Typical EKG findings of an NSTEMI are ST-depression or T-wave inversion. An NSTEMI is a subendocardial infarct involving partial wall thickness, so there is no ST elevation and it later does not progress to a Q wave. A STEMI on the other hand has ST elevation due to full wall thickness injury and later progresses to a Q wave. A STEMI is defined as > **2mm** elevation in contiguous **precordial** leads or > **1mm** in contiguous **limb** leads
 - ▶ **Earliest EKG change of a STEMI: hyperacute peaked T waves**

A review of the leads....

I Lateral	aVR	V1 Septal	V4 Anterior
II Inferior	aVL Lateral	V2 Septal	V5 Lateral
III Inferior	aVF Inferior	V3 Anterior	V6 Lateral

What can cause ST elevation on an EKG, besides an MI?

Electrolytes (hyperkalemia)

Left bundle branch block

Early repolarization

Ventricular hypertrophy

Aneurysm (left ventricular aneurysm)

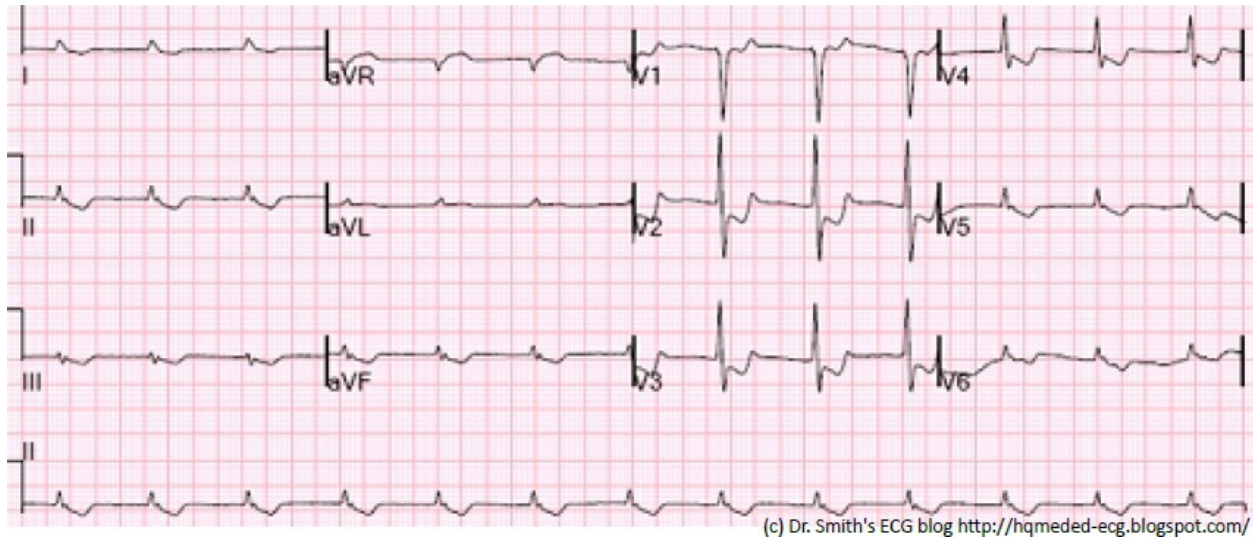
Treatment (inserting the needle too far during pericardiocentesis)

Injury (myocardial contusion)

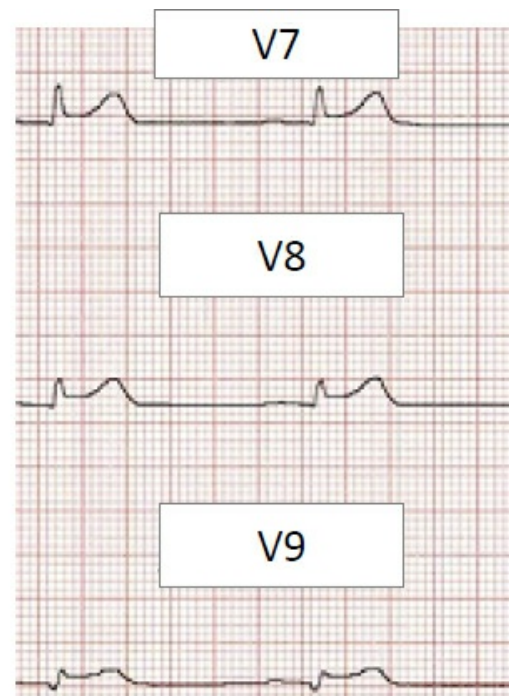
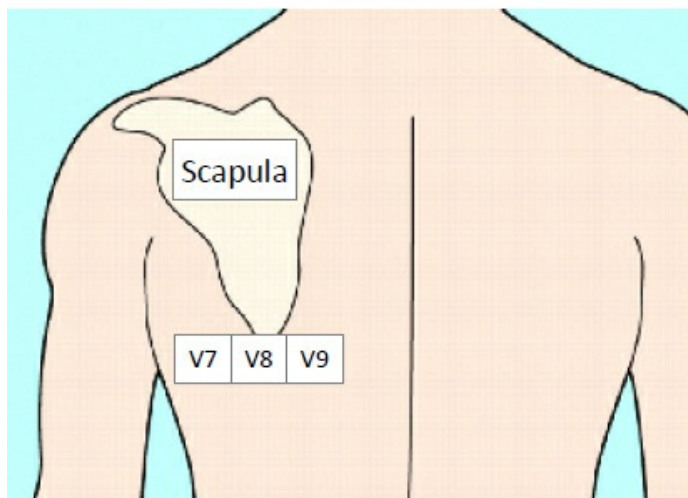
Osborne waves (hypothermia)

Non-occlusive vasospasm

What about a posterior MI? Take this EKG for instance:

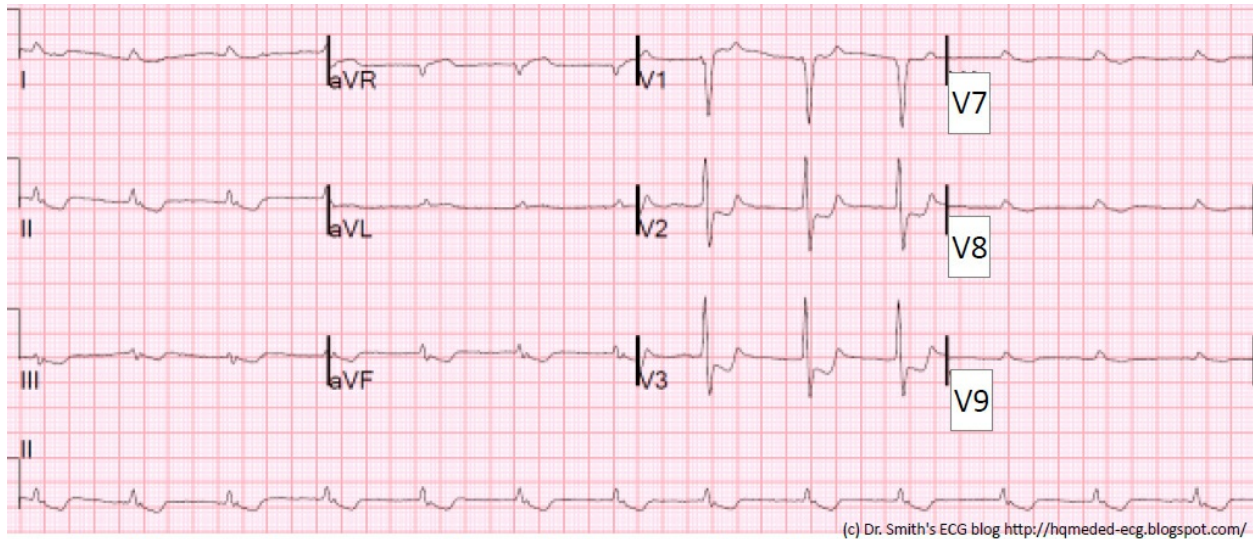


There's ST depression in V2 and V3 with tall R waves, suggesting a posterior STEMI. Place leads V4-6 in the same location, but on the back, and they now become V7-9



V7-9 have elevation so this is a posterior MI. The degree of elevation in posterior leads is usually subtle and only 0.5mm of elevation is needed here to make the diagnosis! Posterior extension of an inferior or lateral infarct implies a much larger area of myocardial damage and an increased risk of left

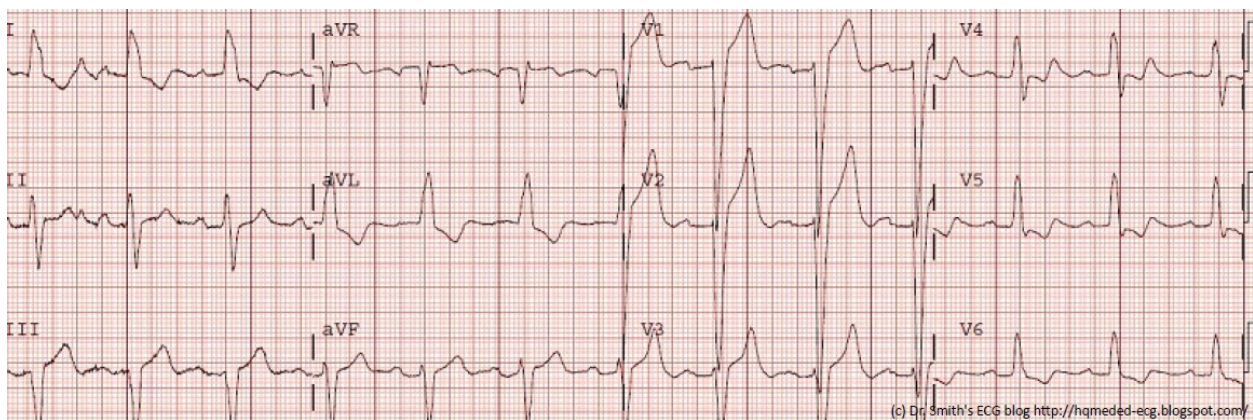
ventricular dysfunction and death.



What if this was the EKG you obtained when you placed posterior leads?
There's no elevation in V7-9, but the rhythm is an accelerated junctional rhythm

This is the most common manifestation of digoxin toxicity
This patient in fact had digoxin poisoning!

In the setting of a left bundle branch blocks, is this an MI?

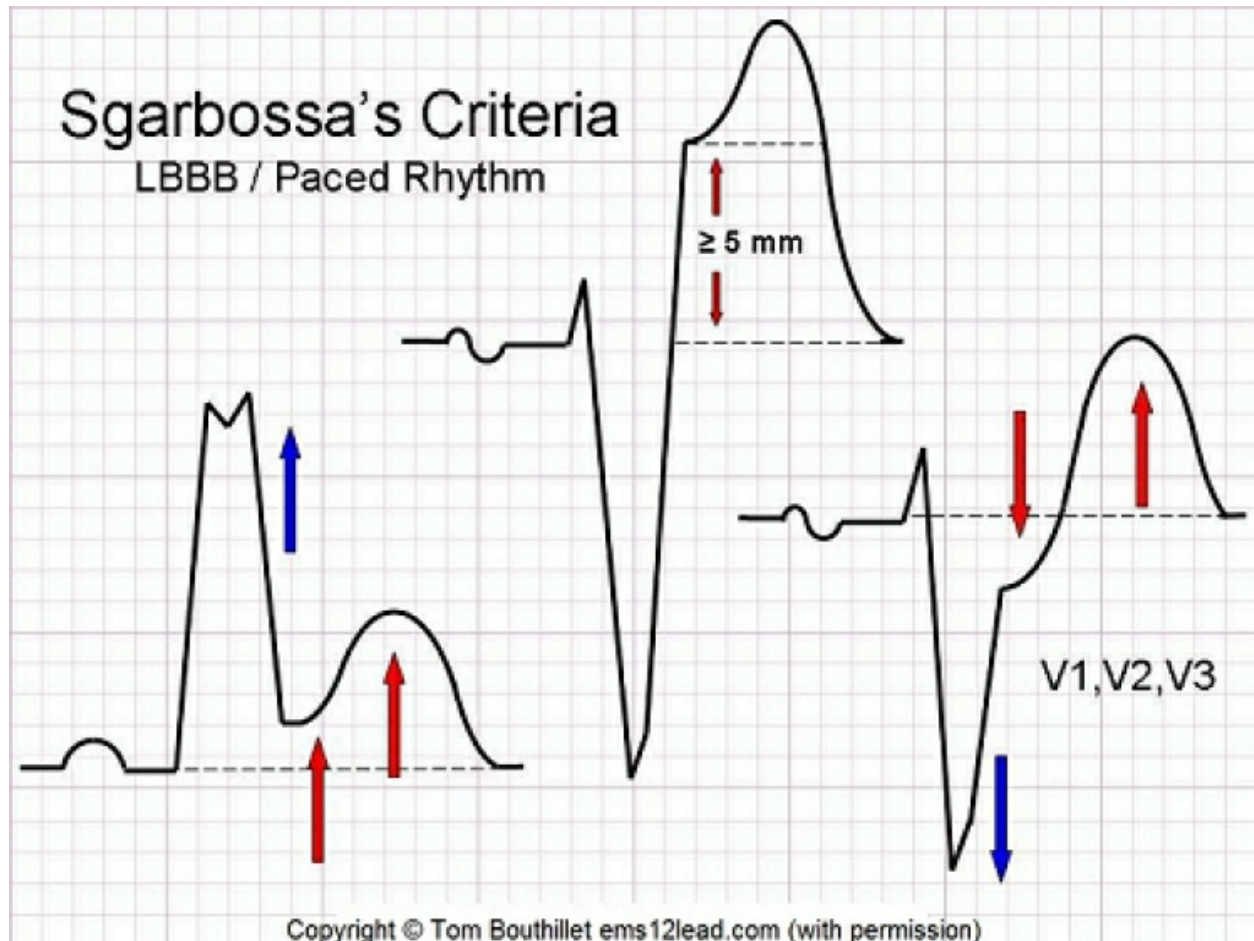


Answer: No

Sgarbossa's Criteria are helpful to diagnose an acute MI in the setting of a LBBB

- 5 points ST elevation that is concordant with QRS in at least one lead
- 3 points ST depression > 1 mm in V1-V3
- 2 points ST elevation > 5 mm discordant with QRS

***** > 3 points has 90% specificity for STEMI



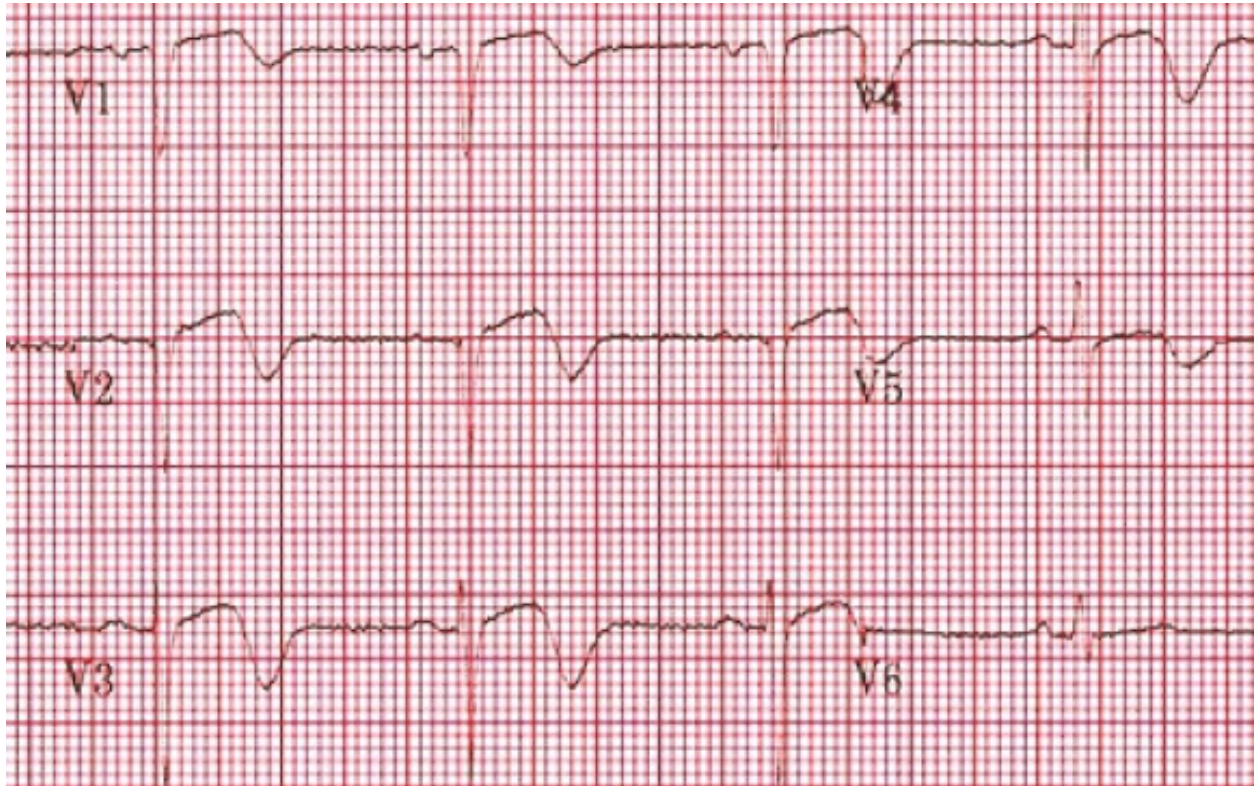
You don't need to memorize this, but just know that 'modified Sgarbossa's criteria' also exist: they replace the last criteria (worth 2 points) with an ST/S ratio < 0.25

What if a patient has a NEW left bundle branch block? In the old days, that was considered a 'STEMI equivalent' – not so anymore. In fact a 2013 LLSA article covered this exact topic – taking all patients with new LBBB to the cath lab lead to a high number of unnecessary activations, and more than 90% of patients with LBBB evaluated in the ER don't have acute coronary

occlusion.

Another STEMI-equivalent to be aware of: Wellens' Syndrome

Characteristic finding: Anterior T wave inversions / biphasic T waves



What's the big deal...this doesn't look like a STEMI to me

It is a big deal! These findings are associated with significant LAD blockages and in the right clinical setting, the patient should go to the cath lab!

Remember that

Wellens' is a *syndrome* and not just an ECG finding: the biphasic T waves occur due to spontaneous temporary reperfusion of an occluded LAD vessel , so they are present when the patient is *not* actively having chest pain.

Troponins are negative.

- Populations at risk for 'silent MI': diabetics, older patients, **women > men**
- Biomarkers
 - ▶ Myoglobin : poor specificity but early detection (rises within 2-3 hours)

- ▶ Troponin : rises within 6 hours and stays elevated for 1-2 weeks
- ▶ CK-MB : almost equally as specific as troponin – the difference is that it stays elevated for 1-2 days and therefore is especially useful to detect reinfarction (for instance a patient develops chest pain shortly after being diagnosed with an MI – troponin is still bumped from the first admission)
- Types of MI
 - ▶ Type 1: MI due to ischemia
 - ▶ **Type 2:** MI secondary to ischemia caused by increased oxygen demand or decreased oxygen supply (HTN, coronary artery spasm, anemia)
 - ▶ Type 3: Cardiac arrest or other sudden unexpected cardiac death accompanied by symptoms suggestive of myocardial ischemia
 - ▶ Type 4: MI associated with angioplasty or stents
 - ▶ Type 5: MI associated with CABG

For instance, if a patient's blood pressure is 210/90 and they have an increased troponin level: which type of MI are they having?

Type 2 MI due to demand ischemia

- Treatment of Acute MI
 - ▶ Beyond the basics, the big one to know is thrombolysis vs PCI : major indication for thrombolysis is if PCI will be delayed > 90 minutes.

Did the thrombolytics help? Evidence of reperfusion after thrombolysis:

- ▶ Chest pain resolves
- ▶ ST segments return to baseline
- ▶ Appearance of reperfusion dysrhythmias (PVCs, non-sustained VT)

- **Complications of Acute MI**

Anterior MI causes the more serious Mobitz II and complete heart block

Inferior MI causes bradycardia and 1° AV blocks

Inferior MI actually causes complete heart block more often than anterior MI:

but complete heart block after an inferior MI is transient; atropine is sufficient in most cases.

- ▶ Post-MI ventricular arrhythmias:
 - ◆ 60% of all deaths associated with acute MI occur within the first hour and are attributable to a ventricular arrhythmia (especially Vfib)
 - ◆ PVCs: usually asymptomatic and not associated with an increased risk for sudden cardiac death
- ▶ Ventricular free wall rupture
 - ◆ *Most common cause of death after the first few hours*
 - ◆ Leads to death by cardiac tamponade
 - ◆ Most occur *within the first week* after AMI
- ▶ Acute mitral regurgitation secondary to papillary muscle rupture
 - ◆ Typically occurs 1-14 days after AMI
- ▶ Left ventricular aneurysm
 - ◆ More than 80% affect the anterolateral wall
 - ◆ **EKG: persistent ST elevation for weeks following an AMI**
 - ◆ Treatment: consider anticoagulation and surgical resection
- ▶ Dressler Syndrome
 - ◆ Occurs 2-8 weeks after AMI
 - ◆ Fever, leukocytosis, friction rub, pericardial effusion
 - ◆ Treatment: NSAIDs and steroids

To summarize: Post-MI complications

Ventricular arrhythmias	Within the first hour
Ventricular free wall rupture	Within the first week
Papillary muscle rupture	1-14 days after MI
Dressler Syndrome	2-8 weeks after MI

Keep in mind the possibility of cardiac stent thrombosis. This can present as a STEMI, NSTEMI, or chest pain: it is *not* limited to STEMI. It can be early or late (a year or more later). Noncompliance with antiplatelets is a major risk factor, but so is cocaine abuse (which activates platelets). Treatment is PCI.

Let's say you are given the scenario of a patient with chest pain and pulmonary edema. Physical exam reveals a murmur. EKG shows ST elevation in the inferior leads: the answer will be 'acute papillary muscle rupture' and not 'STEMI'.

- **Right Ventricular Infarction**
 - ▶ Complicates about 40% of inferior MIs
 - ▶ **ST elevation in lead III > lead II** is highly suggestive of right ventricular involvement
 - ▶ Signs of right heart failure (JVD, hypotension, pulmonary edema)
 - ▶ Use nitrates and morphine with caution and give IV fluids if necessary

HEART FAILURE

Which of the following statements is true regarding heart failure?

- A) Both systolic and diastolic heart failure are associated with impaired contractility
- B) Hepatomegaly and pedal edema are more commonly associated with left-sided heart failure
- C) Most patients with systolic heart failure have some degree of diastolic dysfunction as well
- D) Left ventricular filling pressure is higher in systolic dysfunction

Answer: C

Explanation: Congestive heart failure can be classified as systolic vs diastolic or as left-sided vs right-sided. Most patients with systolic dysfunction have some degree of diastolic failure as well. Systolic failure refers to a problem with contractility while diastolic failure refers to impaired relaxation.

Diastolic failure occurs due to increasing wall thickness (from hypertension for instance). A stiffer left ventricle has less compliance and relaxation so left ventricular pressures need to be higher to maintain cardiac output.

Hepatomegaly and pedal edema are more common in right-sided failure while pulmonary edema occurs in left-sided cases.

CAUSES

High output failure

- ▶ Thyrotoxicosis
- ▶ Anemia
- ▶ AV fistula
- ▶ Pregnancy
- ▶ Paget's disease of bone

Low output failure

- ▶ HTN
- ▶ CAD
- ▶ Valvular heart disease
- ▶ Ischemic cardiomyopathy
- ▶ Chronic alcoholism

Choosing the right one from the right list is a question that has been known to show up...

- Acute decompensated heart failure
 - ▶ Most sensitive finding: dyspnea on exertion
 - ▶ Most specific finding in history: paroxysmal nocturnal dyspnea
 - ▶ Most specific finding on physical exam: S3 gallop
- Treatment:
 - ▶ Nitrates and diuretics are first-line. In fact, 'time to diuretic' is a metric being measured at some hospitals for all patients with a diagnosis of "CHF exacerbation".

INFECTIVE ENDOCARDITIS

- Hypothetically speaking, ABEM hasn't had a question on endocarditis in a few years. But it's just uncommon enough with just the right amount of tricky features to be asked about. So don't stress out over keeping all of these details straight – odds are, you won't see a question on endocarditis.
- Fever and heart murmurs are present in about 90% of patients, while peripheral symptoms are only seen in approximately 10%
- Physical exam: petechiae, subungual (splinter) hemorrhages, Osler nodes (tender subcutaneous nodules usually found on the distal pads of the digits), Janeway lesions (nontender maculae on the palms and soles), Roth spots (retinal hemorrhages)
- Risk factors
 - ▶ Rheumatic or congenital heart disease
 - ▶ Prosthetic valve
 - ▶ IV drug user
 - ▶ Mitral valve prolapse
 - ▶ Cardiac pacemaker
 - ▶ Prior history of endocarditis
- Mitral valve involvement is most common, followed by the aortic and then tricuspid valve (exception: in IV drug users, tricuspid valve is most common)
- Native valve endocarditis ~ *S. aureus* and then *Strep viridans*
- Endocarditis in an IV drug user ~ *S. aureus* (tricuspid valve)
- Prosthetic valve endocarditis
 - ▶ Early – *Staph epidermidis* and *S. aureus* (within 2 months)
 - ▶ Late – *Strep viridans* (after 2 months)

- Left-sided endocarditis
 - ▶ Cause of death is usually heart failure
 - ▶ Emboli cause: **CNS and systemic infarction**
- Right-sided endocarditis
 - ▶ **Less heart failure, lower mortality**
 - ▶ Emboli cause: **Pulmonary infarction and infection**
 - ▶ Associated with IV drug abuse
- Surgical indications for native valve endocarditis:
 - ▶ Heart failure directly related to valvular dysfunction
 - ▶ Severe aortic or mitral regurgitation
 - ▶ Presence of fungal or other highly resistant organisms
 - ▶ Perivalvular infection with abscess or fistula formation
 - ▶ Multiple major emboli
- Management: draw 2 blood cultures from 2 different sites and start vancomycin. Examples of procedures requiring prophylaxis: dental cleaning, rigid bronchoscopy, and cystoscopy (not endoscopy or colonoscopy). In such cases, the primary antibiotic regimen is one dose of amoxicillin 2gm PO.

VALVULAR DISEASE

- Rheumatic heart disease
 - ▶ Acute rheumatic fever can occur 2-4 weeks after GAS pharyngitis
 - ▶ Jones criteria for acute rheumatic fever: arthritis, carditis, chorea, subcutaneous nodules, and erythema marginatum
 - ▶ Patients can suffer from pericarditis, myocarditis, or valvulitis. Rheumatic heart disease may develop (typically 10-20 years later) and is the most common cause of *acquired* valvular disease in the world

- ▶ Mitral regurgitation is the most common early valvular manifestation

The reason to treat all cases of Strep pharyngitis is to prevent rheumatic fever. This is a controversial topic as the NNT is astronomical to prevent one case of rheumatic fever. The fact remains: for testing purposes, you treat.

- Aortic stenosis – 5 Facts:

1 – It can either be congenital or acquired

2 – Classic presentation: exertional dyspnea, chest pain, and syncope

3 – Murmur: Crescendo-decrescendo systolic murmur that **radiates to the carotids**

4 – Avoid certain medications. In patients with AS and angina, beta blockers may be okay. Otherwise, avoid beta and calcium channel blockers as well as nitrates. Hydralazine is the drug of choice to treat elevated blood pressure in this population.

5 – Phenylephrine is the vasopressor of choice for hypotensive patients with AS. It increases diastolic blood pressure, improving coronary perfusion.

Be very careful when intubating a patient with aortic stenosis! These patients depend on adequate preload to maintain cardiac output, which puts them at high risk for peri-intubation hemodynamic collapse. Prior to induction, optimize the preload with IV fluids if needed and have push-dose vasopressors available.

- Mitral Stenosis

- ▶ Dyspnea on exertion, orthopnea, PND
- ▶ Loud S1, opening snap
- ▶ EKG: Afib, left atrial enlargement
- ▶ **Suspect in a pregnant woman with murmur and pulmonary edema**

- Mitral Regurgitation

- ▶ Etiology can be acute or chronic:
 - ◆ Acute – chordae tendinae rupture, papillary muscle dysfunction
 - ◆ Chronic – rheumatic heart disease

- ▶ Most often caused by rheumatic heart disease, leading to chronic slow progression of shortness of breath
- ▶ Loud holosystolic murmur that radiates to the axilla

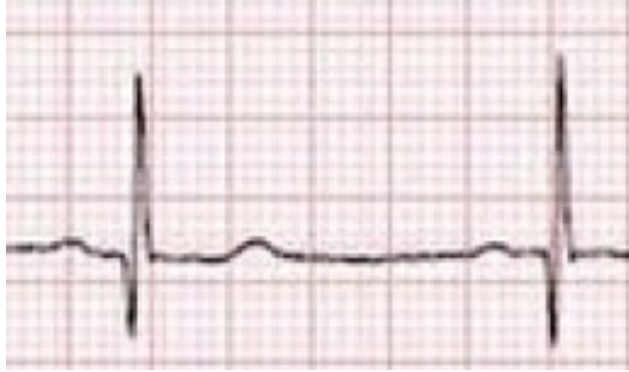
Which of the following is true regarding mitral valve prolapse?

- A) Commonly associated with atrial fibrillation
- B) Most often found in older females
- C) Auscultation will reveal a mid-systolic click
- D) All of the above are true

Answer: C

Explanation: Mitral valve prolapse is most common in young females. Patients may experience palpitations due to premature atrial contractions, premature ventricular contractions, or paroxysmal supraventricular tachycardia (PSVT). Atrial fibrillation is not typically seen in these patients.

- Hypertrophic Cardiomyopathy
 - ▶ Autosomal dominant inheritance
 - ▶ Frequently asymptomatic until sudden cardiac death
 - ▶ Chest X-Ray: can be normal or can show cardiac dilatation if left atrium is enlarged
 - ▶ EKG: large dagger-like q waves (aka 'septal q waves') in the lateral leads
 - ▶ Treatment: beta blockers and placement of an implantable cardiac defibrillator (ICD)
 - ▶ Major cause of death: Vtach or Vfib



PERICARDITIS

What is the most likely cause?

Infectious (viral)

How does it present?

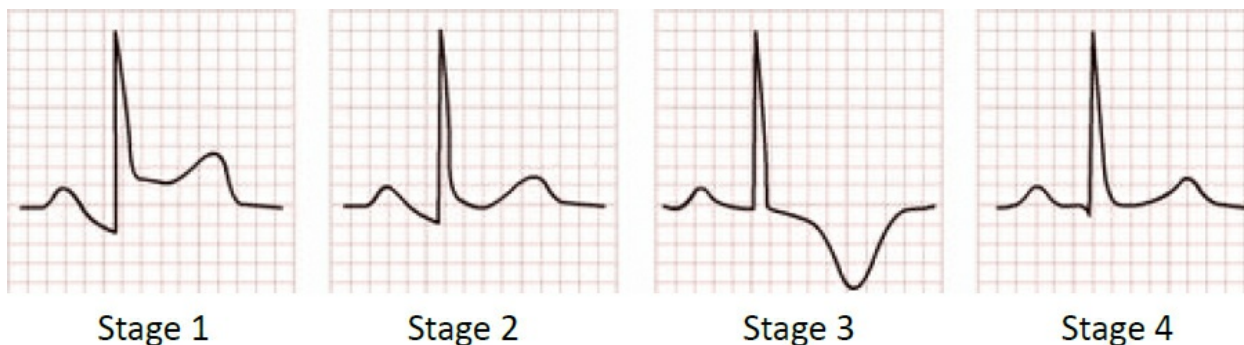
Sharp pleuritic chest pain which may be relieved by sitting forward, fever, malaise

Physical exam findings?

Pericardial friction rub – a superficial squeaking sound best heard with the diaphragm of the stethoscope over the left sternal border

4 stages of EKG findings:

- ▶ Diffuse ST elevation and **PR depression** (this is the most specific finding for pericarditis)
- ▶ ST segments return to baseline
- ▶ T wave inversion
- ▶ Normalization of EKG



Are there criteria that will help make the diagnosis?

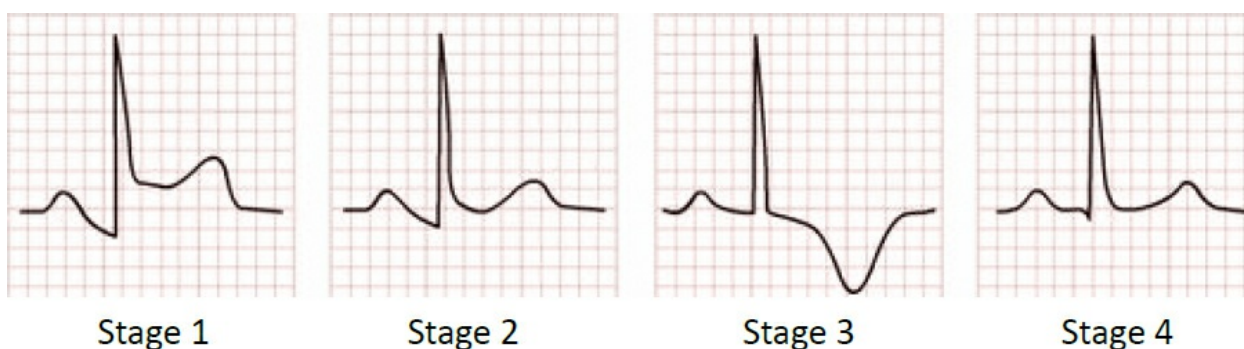
Patients must have at least two of the following: typical chest pain, pericardial friction rub, EKG changes, new or worsening pericardial effusion

How about labs?

Cardiac enzymes can be increased and in such cases patients should be considered to have myopericarditis

Treatment:

Combination therapy with NSAIDs and colchicine for any first episode of pericarditis – studies have shown that when used together, there is a decreased rate of recurrent pericarditis. Ultimately just treat the underlying cause.



Knowledge bomb! Chest pain and EKG findings are typically absent in patients with uremic pericarditis (rather than inflammatory cells in the myocardium there is fibrin deposition)

ACC/AHA guidelines recommend that all patients with suspected pericarditis have an ultrasound to rule out **Pericardial Tamponade:**

- ▶ Beck's triad → JVD, hypotension, and muffled heart sounds
- ▶ EKG: electrical alternans
- ▶ Echocardiogram: effusion and RV diastolic collapse (very specific)
- ▶ Treatment: IV fluid bolus *then* pericardiocentesis

What about **myocarditis**?

Clinical presentation is highly variable and can range from vague complaints like fatigue to chest pain to cardiogenic shock. Patients can even present with sudden cardiac death! EKG can be normal or can have ST elevation, cardiac enzymes can be normal or high. Seeing a pattern here? Typical patient – a young male who presents with otherwise unexplained cardiac abnormalities of new onset, such as heart failure, MI, arrhythmias, or conduction disturbances. Some patients have a history of recent viral illness. There are countless lawsuits of young healthy patients who presented with URI symptoms and tachycardia and were discharged home only to have a bad outcome and diagnosis of myocarditis later. The most effective diagnostic test is a cardiac MRI.

HYPERTENSION

Which of the following hypertensive conditions is most easily reversible with medication?

- A) Renal failure
- B) Encephalopathy
- C) Aortic dissection
- D) Acute coronary syndrome

Answer: B

Distinguish between hypertensive urgency (asymptomatic high blood

pressure, typically $< 180/110$) and hypertensive emergency (evidence of end-organ damage). End-organ damage can manifest in the heart (angina, CHF, MI, dissection), CNS (encephalopathy), kidneys (renal failure), and eyes (flame-shaped hemorrhages, soft exudates). In hypertensive urgency the goal is to reduce BP over several hours to days; with emergency, the goal is to reduce MAP by 25% in the first 24 hours.

Remember, $MAP = 2/3 DBP + 1/3 SBP$

If the question gives you a scenario wherein a patient has not been taking his home meds and his BP is 180/110. He has a severe headache but CT is negative: what is the next best step?

For this case of hypertensive urgency, restart oral meds and discharge home with close follow-up.

Nitrates dilate both arteries and veins so lead to significant drops in blood pressure, even in small doses. They can cause a reflex tachycardia. Labetolol is an alpha and beta blocker and is therefore contraindicated in bronchospasm, acute decompensated CHF, and bradycardia. Hydralazine is a direct arterial vasodilator and is the drug of choice for pregnancy-induced hypertension.

AORTIC DISSECTION

A 55 year old male presents to the ER with sudden onset chest and back pain. Vital signs show a blood pressure of 170/90 and heart rate of 80/min. A chest x-ray is ordered; what is the next best step?



- A) Order a CT angiogram of the chest
- B) Start an esmolol drip
- C) Intubate the patient in preparation for surgery
- D) Call the cardiologist for a bedside transesophageal echocardiogram
- E) Start a nitroprusside drip

Answer: B

Explanation: This patient has a suspected aortic dissection based on history, presentation, and x-ray findings (widened mediastinum). The next step is to lower the heart rate – this is best achieved with beta blockers such as esmolol or labetalol. The target heart rate is $< 60/\text{min}$. Once this is done, blood pressure should be lowered to a target systolic of 100-120 mmHg. Nitrates are often used. They should not be given until beta blockade is achieved as they can cause reflex tachycardia: increasing shearing forces and worsening the condition. After heart rate and blood pressure have been stabilized, a CT scan should be ordered to confirm the diagnosis and determine how extensive

the dissection is. TEE is the test of choice for unstable patients. The number one risk factor is a history of chronic hypertension – however, there may be no history of hypertension at all.

If this question was asked differently – for instance: ‘what is the most SPECIFIC test that can be rapidly obtained to diagnose aortic dissection?’ then the answer would be ‘CT angiogram’.

Dissections are classified as:

Stanford A (ascending aorta, surgery) or Stanford B (descending aorta, medical) Debakey I (ascending aorta + arch), Debakey II (ascending), Debakey III (descending)

- Pulse deficits and asymmetric upper extremity blood pressure may be seen but cannot be relied upon to rule in or rule out dissection. A blood pressure difference > 20 mmHg between arms is, however, a poor prognostic factor and associated with higher mortality.
- EKG may show signs of acute MI if the dissection is proximal
- Chest x-ray can be normal in anywhere from 10-40% of cases depending on which study you are looking at. Findings that suggest dissection include widened mediastinum, intimal calcium separation (most specific sign: extension of aortic shadow > 5 mm beyond calcified aortic wall), and a left pleural effusion.

ABDOMINAL AORTIC ANEURYSM

- Focal dilation of the aorta; usually results from weakness of the tunica media leading to a slow and continuous dilation. Most AAA are

asymptomatic until they expand or rupture. An expanding AAA causes sudden, severe, and constant low back/abdominal pain. For this reason, the most common misdiagnosis is 'renal colic'. Syncope may be the presenting complaint.

- In aortic dissection, hypertension is the #1 risk factor; with AAA, smoking appears to be the #1 risk factor (tobacco use causing atherosclerosis)
- On physical exam, audible bruits are rare. Aneurysms that are 4-5cm in size are typically palpable. Rupture of an aneurysm due to vigorous palpation is almost unheard of.

What is the most important factor in determining risk of rupture of a AAA?

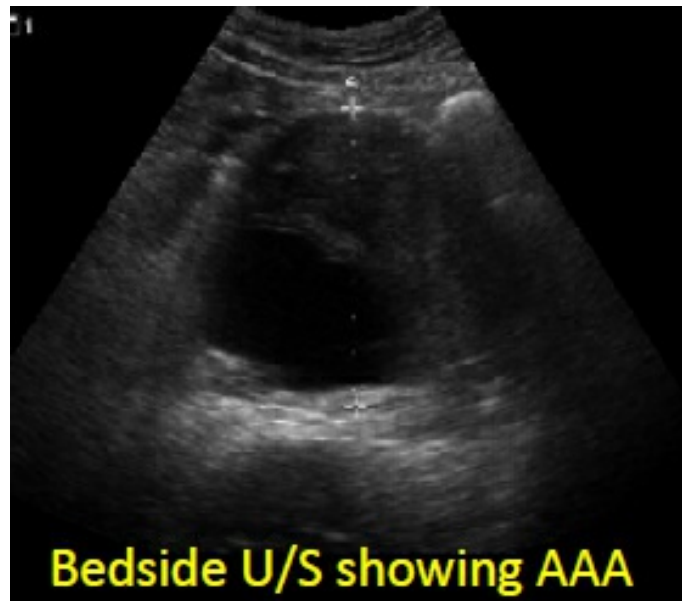
- A) Blood pressure
- B) Sex of the patient
- C) Location of the aneurysm
- D) Size of the aneurysm

Answer: D

Explanation: Risk of rupture is small if the aneurysm measures $< 4\text{cm}$ and significantly higher when $> 5\text{cm}$. Plain films are very limited, but curvilinear calcifications of the aortic wall can be suggestive. Ultrasound is an excellent bedside screening tool with high sensitivity. If the patient is hemodynamically unstable, bedside ultrasound is the test of choice. CT scan is the test of choice in stable patients and it can detect active extravasation/bleeding.

- If a patient is hypotensive or unstable, start IV fluids immediately and prep for OR
 - ▶ There is some evidence that permissive hypotension can actually be beneficial with recommendations to only maintain the systolic > 70
- If the patient is asymptomatic and the AAA is a coincidental finding,

they will need follow up for repeat ultrasound; elective repair is indicated if > 5.5 cm



- Other than a AAA, the most common type of aneurysm in the body is a popliteal artery aneurysm (PAA). In most cases, PAA presents as either an asymptomatic incidental finding or a pulsatile mass. PAA is bilateral in 50% of cases and there is a strong association with AAA (40% of patients with a PAA have a AAA, but only 10% of those with a AAA have a PAA). They may cause severe limb ischemia after acute vessel thrombosis or rupture, and there is a high rate of association with limb loss.

THROMBOSIS

- Acute limb ischemia can lead to loss of limb or even life. The most common cause is chronic atherosclerosis eventually leading to thrombosis of an occluded artery, but embolic phenomenon may also occur.

- ▶ Signs/symptoms of *acute* ischemia – the 6 P's:
- ▶ Pain
 - ◆ Pallor
 - ◆ Pulselessness (late finding)
 - ◆ Paresthesias
 - ◆ Paralysis
 - ◆ Poikilothermia
- ▶ Treatment of acute extremity ischemia is immediate anticoagulation and vascular surgery consultation for potential thrombectomy. Note that after restoring blood flow, **reperfusion injury** can occur. Patients will have muscle pain, swelling, elevated CK levels, hyperkalemia, or renal failure.

About 1/3 of all deaths from occlusive arterial disease are secondary to complications of reperfusion injury!

Leriche's syndrome

Typically affects younger males (30-40 years of age)

A form of peripheral artery disease affecting the abdominal aorta as it transitions into the common iliac artery

Classic triad: impotence, pelvis and thigh claudication, and absence of femoral pulses

- Superficial Thrombophlebitis
 - ▶ Usually benign and self-limited: a patient had an IV placed a few days ago and now they return with a tender palpable cord. You prescribe warm compresses and NSAIDs. Pretty straightforward right? Well...these *can* lead to DVT, so nearly all patients deserve an ultrasound. The American College of Chest Physicians recommends anticoagulation for patients with lower extremity superficial thrombophlebitis at increased risk for thromboembolism: affected venous segment ≥ 5 cm, proximity to deep venous system ≤ 5 cm, and presence of risk factors for DVT formation.



- Deep Vein Thrombosis is best diagnosed using duplex ultrasonography. If the initial ultrasound is negative but clinical suspicion (or high-sensitivity d- dimer) is high, prescribe aspirin once daily for seven days (barring any contraindications) and have the patient return for repeat ultrasound. Treatment is anticoagulation: duration and agent of choice are debatable.

In those with suspected DVT, the Wells Score can help guide decision-making; a score < 2 makes presence of a DVT unlikely while ≥ 2 makes it more likely.

Modified Wells Criteria for Predicting the Probability of a DVT

Clinical Characteristic(s)	Score
Active cancer	+1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	+1
Recently bedridden for three days or major surgery within the last 12 weeks	+1
Localized tenderness along the deep venous system	+1
Entire leg swollen	+1
Calf swelling ≥ 3 cm larger than asymptomatic side	+1
Pitting edema confined to symptomatic leg	+1
Collateral superficial veins	+1
Previously documented DVT	+1
Alternative diagnosis at least as likely as a DVT	-2

- **Phlegmasia cerulea dolens**
 - ▶ Uncommon, severe presentation of DVT

- ▶ Patients present with acute onset of severe and massive swelling/cyanosis from a large iliofemoral clot
- ▶ Treatment includes anticoagulation and possibly thrombolytics (the only real indication to use these in cases of DVT)
- ▶ Consider the possibility of an associated compartment syndrome



A 25 year old male presents to the ER with fever and malaise. He had a skin abscess that was incised/drained four days ago. Labs show leukocytosis and a chest x-ray reveals a RUL infiltrate. Since pneumonia doesn't fit as a diagnosis, you decide to order a CT chest: septic pulmonary emboli.

Septic emboli are often associated with IV drug use or immunosuppressed patients but can also arise from an infectious source that enters the bloodstream and travels to the lungs. Fever is the most common symptom and treatment is antibiotics.

One zebra to think about is **Lemierre's syndrome** – with a peritonsillar abscess the infection (typically *Fusobacterium*) can enter the bloodstream and lead to sepsis.

EKG

A 60 year old female is experiencing chest pain and shortness of breath. Labs reveal a potassium of 6.5. What is the most likely cause of her hyperkalemia?

- A) Lab error
- B) Renal failure
- C) Medication side effect
- D) Hyperglycemia
- E) Vomiting

Answer: A

Explanation: Hemolysis due to the way blood is drawn and/or managed is the most common cause of discovering a high potassium level. In someone with no known renal disease, repeating the blood draw is appropriate. In the meantime obtaining an EKG can be helpful: look for peaked T waves, flat P waves, and prolonged intervals.

Treatment: calcium (most important early treatment for anyone with EKG findings; stabilizes the cardiac membrane), insulin/D50, high-dose beta agonists, sodium bicarbonate, and kayexalate (aka sodium polystyrene sulfate). Kayexalate is an exchange binder that binds potassium and releases sodium (hence contraindicated in CHF) – it is *the only treatment that actually removes potassium* from the body. Its safety has been called into question and it's no longer used as often.

- Hypokalemia
 - ▶ Most common cause: use of diuretics
 - ▶ EKG changes: U waves, prolonged QT
 - ▶ EKG changes don't correlate with the severity of hypokalemia
- Hypercalcemia and hypophosphatemia: shortened QT
- Hypocalcemia and hyperphosphatemia: prolonged QT



Vtach



Polymorphic Vtach

Polymorphic Vtach: Wide complex ventricular tachycardia with rapidly changing QRS morphologies

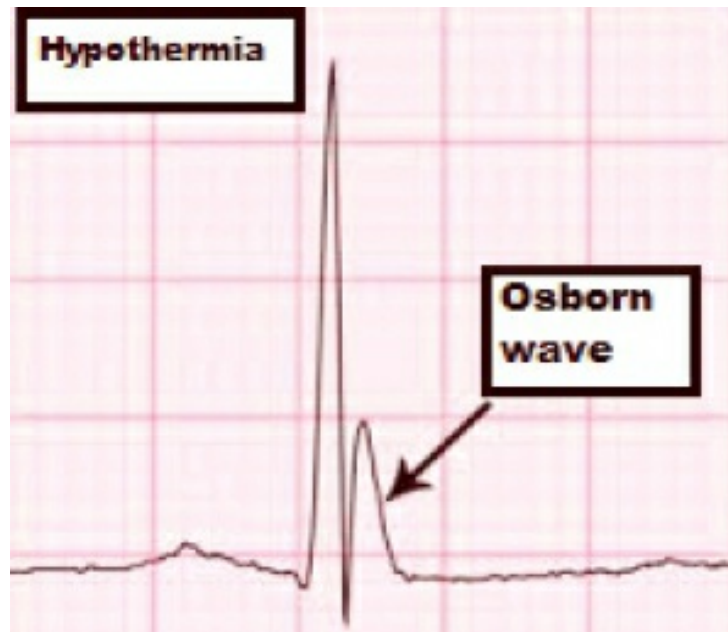
Polymorphic Vtach is either Torsades (associated with prolonged QT) or non- Torsades. The most common underlying cause is myocardial ischemia. *Prolonged QT is defined as > 450 in men and > 470 in women. While it can be congenital, it is most often associated with electrolyte abnormalities (such as a low magnesium level) or with medications. In patients at high-risk, prolonged QT can develop into 'Torsades de pointes'. High-risk patients include those with CAD, women, the elderly, and those with $QT > 500$.*

- **Torsades De Pointes**

- ▶ Most cases are self-limited. If it does not spontaneously convert, then unstable patients should be defibrillated. If it does spontaneously convert, it will likely recur and therapy is aimed at preventing recurrence.
- ▶ Treatment: remove offending agent, correct hypokalemia, administer 2-4 grams of magnesium *even if levels are normal*, and overdrive pacing
- ▶ Speeding up the resting heart rate will narrow the QT interval. This can be achieved with pacing or with isoproterenol.
- ▶ Do not give amiodarone or procainamide as they further prolong QT

- Hypothermia

- ▶ J point elevation / Osborn wave : **the height of the Osborn wave is roughly proportional to the degree of hypothermia**
- ▶ Slowed conduction leads to prolongation of all ECG intervals, including PR, QRS, and QT
- ▶ Don't use pacing in patients with severe hypothermia as it can induce Vfib.



- Digoxin Toxicity
 - ▶ 'Digoxin effect' refers to downsloped ST depression (not a sign of toxicity)



- ▶ Toxicity can be enhanced by the presence of hypokalemia

- ▶ Bradyarrhythmias are more common in younger patients
- ▶ Tachyarrhythmias are more common in patients with cardiac disease
- ▶ 3 arrhythmias to know about:
 - 1) PVCs are the most common and often the first sign of toxicity
 - 2) Paroxysmal atrial tachycardia, often with 2:1 AV block
 - 3) “Bidirectional Vtach” in which the rhythm is regular but every other beat has a different axis as it travels alternately down different conduction pathways (unique but not specific for digoxin toxicity)



- ▶ Treatment is digibind; indications include: cardiac arrest, life-threatening dysrhythmia, potassium level > 5 , ingestion $> 10\text{mg}$ (adult) $> 5\text{mg}$ (child)
 - ▶ Phenytoin and lidocaine may also be effective for treating arrhythmias
- Tricyclic Antidepressants
 - ▶ The two main adverse events of poisoning are seizures and ventricular dysrhythmias
 - ▶ EKG may show interventricular conduction delay (prolonged QRS) and/or right axis deviation of the terminal QRS complex
 - ▶ QRS $> 100\text{msec}$ is predictive of seizures and $> 160\text{ msec}$ Vtach
 - ▶ Treatment: **sodium bicarbonate until QRS interval normalizes.** Consider hyperventilation to maintain a state of alkalosis. Lidocaine is third-resort.
 - ‘Holiday Heart’ Syndrome

- ▶ Term used to describe short-lived arrhythmia associated with alcohol use
- ▶ Symptoms typically last a few seconds and most resolve within 24 hours
- ▶ Consider the diagnosis in patients without heart disease who have new-onset atrial fibrillation
- Supraventricular Tachycardia (SVT)
 - ▶ Regular, narrow complex tachycardia (rate 150-200)
 - ▶ Treatment: The first step is to attempt **vagal maneuvers** (Valsalva, carotid massage, gag reflex, etc). Next, administer **adenosine 6mg** (repeat at 12mg, and a third dose at 12mg). If none of these are successful and the patient remains in SVT, order a dose of a **calcium channel or beta blocker**.



Adenosine has an excellent safety profile, but it may cause transient chest pain/dyspnea and is relatively contraindicated in acute asthma exacerbations.

- Multifocal Atrial Tachycardia (MAT)
 - ▶ Irregularly irregular, narrow complexes, rate > 100
 - ▶ Most frequently associated with **COPD**, CHF, pneumonia, and the elderly
 - ▶ **Defined as three or more nonsinus foci** (producing at least three different P wave morphologies)
 - ▶ Treatment: IV magnesium and address the underlying cause

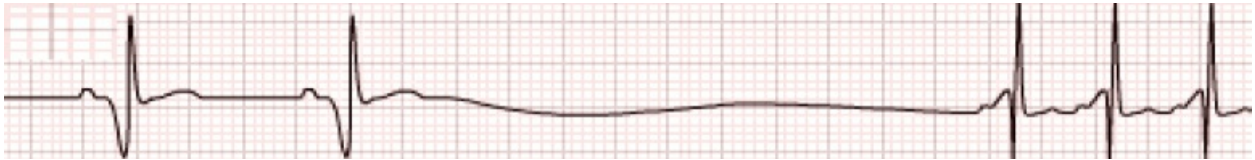


- Brugada Syndrome is the most common cause of sudden death in young males with heart disease; can lead to syncope or sudden death by inducing Vfib. It's much more common in men and inherited in an autosomal dominant pattern. EKG shows persistent ST elevation in leads V1-V3 with a RBBB appearance. Treatment: place an ICD.



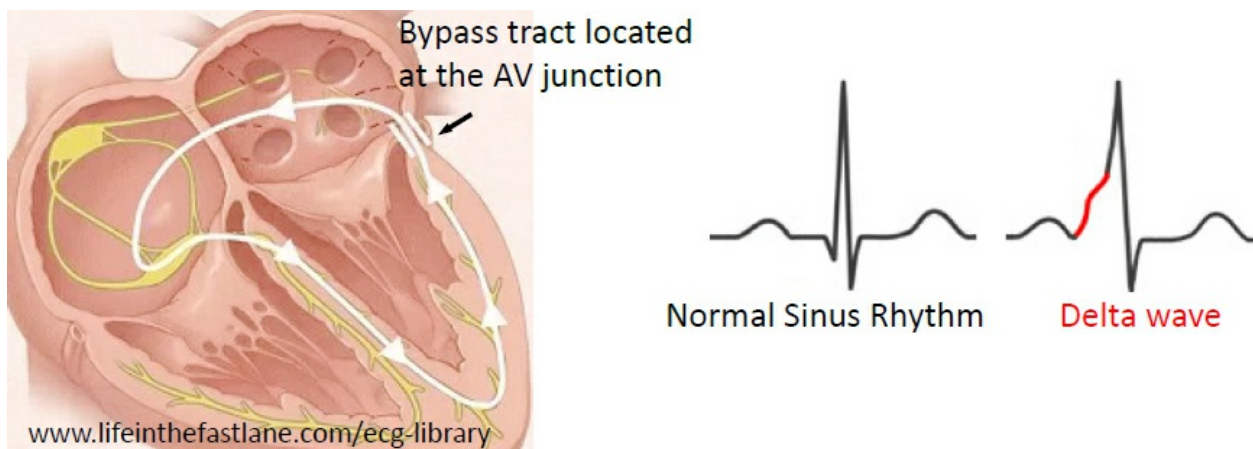
- **Commotio Cordis**
 - ▶ Vfib that occurs after a blunt injury to the chest in a patient who has *no structural heart disease* (for instance a healthy young pitcher is playing baseball and gets hit in the chest with the ball)

- Sick Sinus Syndrome
 - ▶ EKG findings: severe bradycardia, pauses, and alternating tachy-brady
 - ▶ Signs and symptoms: fatigue, dizziness, chest pain, palpitations, syncope
 - ▶ Can result from anything that causes damage to the SA node such as sarcoidosis, amyloidosis, or even just severe coronary artery disease



- **Wolff-Parkinson-White Syndrome (WPW)**

WPW is a combination of a congenital accessory pathway and episodes of tachyarrhythmia. Accessory pathways (or ‘bypass tracts’) are abnormal pathways that conduct impulses. AVRT stands for ‘atrioventricular reentry tachycardia’ – meaning the bypass tract is located between the atria and ventricles. WPW is a type of AVRT. AVRTs are further divided into orthodromic or antidromic depending on the direction of reentry conduction. Classic EKG findings are a short PR (delta wave) and prolonged QRS interval.



AVRT with **orthodromic** conduction typically has a heart rate of 200-300/min and narrow QRS complexes. This is treated with **vagal maneuvers, adenosine**, calcium channel blockers, etc. AVRT with **antidromic** conduction typically has a heart rate of 200-300/min but with **wide QRS complexes**. This can be

mistaken for Vtach. Treatment includes **amiodarone or procainamide** in stable patients, cardioversion if unstable (**avoid ABCD**: adenosine, beta blockers, CCB, and digoxin - these drugs block the AV node but not the bypass tract: all impulses will go through the bypass tract, potentially causing ventricular tachycardia).

What about Afib with WPW? EKG will show an irregular WIDE complex tachycardia with rates ~ 300/min and bizarre/varying QRS morphologies. Treat unstable patients with cardioversion; procainamide or ibutilide for stable ones. Amiodarone is controversial as it can cause decompensation into Vfib.

- **First degree heart block**

- ▶ PR interval > 200 msec
- ▶ Treat only if the patient is symptomatic

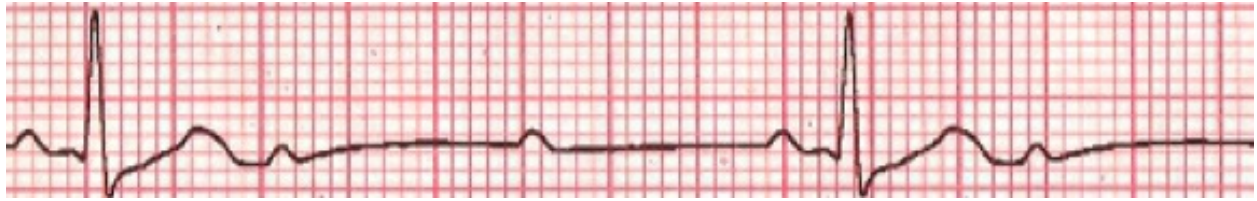


- **Second degree heart block**

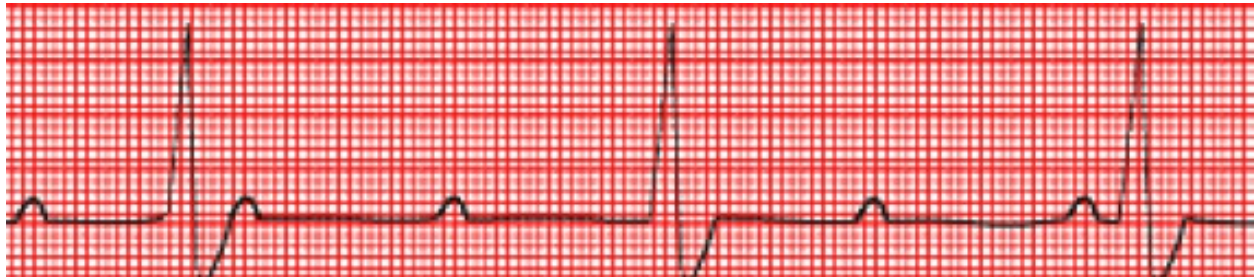
- ▶ Mobitz I: P-R intervals progressively prolong until one beat is dropped



- ▶ Mobitz II: P-P and P-R intervals are regular until one beat is dropped, **R-R interval is irregular**



- **Third degree heart block aka Complete heart block**
 - ▶ The P-P and R-R intervals are regular; P-R intervals are irregular



Remember!

Inferior MI : first degree and Mobitz I blocks

Anterior MI : Mobitz II and third degree blocks...

BUT

If a patient has an inferior MI and now has a third degree block, it's most likely transient and self-limited

Junctional Escape Rhythm

Narrow complex, regular, rate 40-60



Ventricular Escape Rhythm

Wide complex, rate > 40



Escape rhythms occur when a pacemaker other than the sinus node takes over. In complete heart block, the escape rhythm that controls the ventricles can occur at any level below the block and the QRS morphology can help determine where the impulse to conduct is coming from. Atropine is much less likely to be effective for ventricular escape rhythms.

PACEMAKERS

- **Which vessel is the preferred site of insertion?**

The catheter tip should end in the right ventricle; the best choice is the right internal jugular vein and next best is the left subclavian vein.

- Applying a **magnet to a pacemaker** temporarily 'reprograms' the pacer to asynchronous mode (converts it to fixed-rate ventricular pacing in which constant pacing is delivered regardless of the native rate). Most importantly, a magnet on a pacemaker **will not turn it off**. Applying a **magnet to an ICD will inactivate it**. Why would you need to do this? A few reasons: if it's delivering inappropriate shocks, if you are transcutaneously pacing, if the family wishes to stop resuscitative efforts, etc.

Let's say a patient reports that their ICD fired and delivered a shock to them. You have the device interrogated and it shows that it did not fire. What to do?

The patient most likely had what's known as a 'phantom ICD shock'. Reassure them that it did not actually fire and they may safely be discharged.

CARDIAC ARREST

Most common cause of cardiac arrest in adults: Vfib

vs

Most common cause of cardiac arrest in children: hypoxia

- To identify cardiac arrest in an unresponsive victim, **check a pulse for no more than 10 seconds**
- Neonatal bradycardia is defined as pulse $< 100/m$
 - Give positive pressure ventilation
 - Ensure adequate oxygenation/ventilation
 - If pulse $< 60/m$, start compressions

Asymptomatic bradycardia in children (for instance a 6 month old child with a heart rate of 45) does not require any treatment

- Infants and children who are not breathing but pulse $> 60/m$: give breaths without compressions
- Infants and children who are not breathing and pulse $< 60/m$: give both breaths and compressions

Which of the following is true regarding the use of therapeutic hypothermia in patients who have return of spontaneous circulation after cardiac arrest?

- A) It should be initiated immediately after return of spontaneous circulation
- B) Prehospital cooling has been shown to be more beneficial than waiting until patients' arrival to the hospital
- C) Presence of posturing or unresponsive pupils is an absolute contraindication
- D) Presence of a post-arrest STEMI is an absolute contraindication

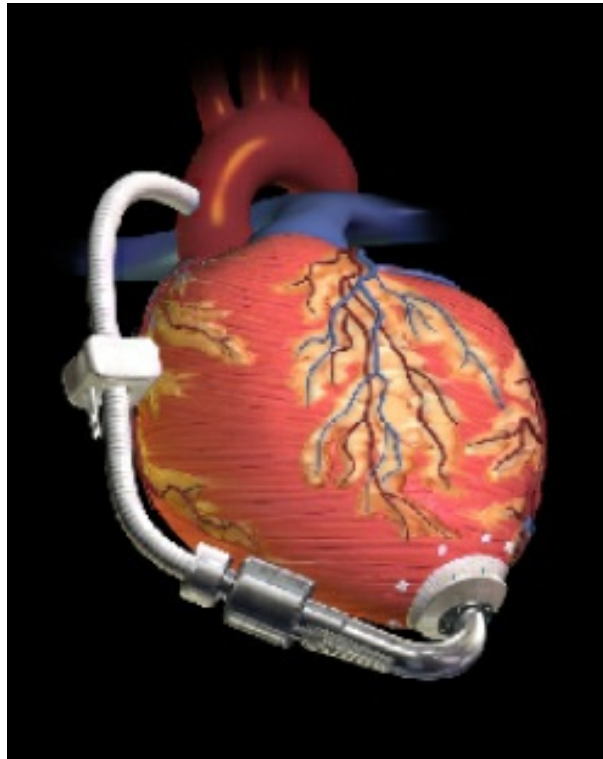
Answer: A

Explanation: There is no benefit to starting the process en route to the

hospital. If cardiac catheterization is indicated, it can be done while the patient is being cooled. Patients should be cooled to 33°C and kept that way for 24 hours, then rewarmed over eight hours. Newer studies have shown that cooling to 36°C requires less vasopressor support and is associated with less hemodynamic instability. According to the AHA, the only absolute contraindications to therapeutic hypothermia are bleeding (noncompressible bleeding or underlying coagulopathy), severe sepsis, and pregnancy.

Newer exams like to ask about LVAD devices. What do I need to know?

LVADs are 'left ventricular assist devices'. They are battery operated pumps that are used in patients with end-stage heart failure. One end of the pump attaches to the left ventricle and the other inserts in the aorta. They are sometimes used as a bridge to transplant but are also used as destination therapy (alternative to transplant).



What complications should you be aware of?

First: if there is any complication, call the VAD coordinator and cardiologist ASAP

Look, listen, and feel:

Look to make sure all lines are connected

Listen for the sound of the motor to make sure batteries are sufficient

Feel for heat – if the box is hot, consider thrombosis

Pump thrombus: increased device power readings but decreased flow.

Treatment is immediate anticoagulation with heparin and consider

thrombolytics.

Patients with an LVAD may not have a palpable pulse – and that's normal. Avoid chest compressions if at all possible! If the motor is working but the patient is decompensating, give IV fluids. Order dobutamine if you think right heart failure is present.

LVAD patients tolerate arrhythmias well and without symptoms (they can be in Vtach or Vfib while awake). Shock if necessary: make sure not to place any of the pads over the device. Avoid compressions at [almost] all cost.

Here's how the question might be worded: **EMS responds to call of an unresponsive patient. They find a pulseless elderly male with an LVAD. Monitor shows Vtach. How should you treat?** Options might include defibrillation at 50 joules, **defibrillation at 200 joules**, CPR, etc: basically treat it like you would other cases - just avoid CPR.

Do I need to know anything about patients who have had a cardiac transplant?

There is no autonomic innervation so the heart rate will be around 90/min. This rate won't change much even with stimulation. In fact, atropine will have no effect on the heart rate. If patients are bradycardic, use isoproterenol.

EKG will reveal two sets of P waves. The recipient's native P waves will have small amplitude, while the donor P waves will appear normal.





GENERAL SKIN CONDITIONS

Which of the following is true regarding atopic dermatitis?

- A) Symptoms tend to worsen in the summer months due to heat and humidity
- B) Clobetasol is a topical corticosteroid that can be used on the face
- C) Triamcinolone is a topical corticosteroid that can be used on the face
- D) This condition is more common in those with a family history of asthma
- E) Eczema vaccinatum is a reaction which can be seen in patients with eczema who receive the influenza vaccination

Answer: D

Explanation: Atopic dermatitis, also known as eczema, is a chronic pruritic skin condition that is more common in those with a family history of asthma and seasonal allergies. It is exacerbated by skin dryness so worse in the winter months. Treatment is non-curative but can help control symptoms; low potency topical corticosteroids (hydrocortisone) can be used for mild/moderate cases and high potency ones for more severe cases. High potency agents such as triamcinolone and betamethasone should not be used on the face. Eczema vaccinatum is a rare but serious reaction seen in those with eczema who receive the smallpox vaccination.



- **Eczema Herpeticum** describes eczema that becomes secondarily infected by herpes virus and is typically seen in areas of prior eczema that are treated with steroids. Get an emergent referral to a dermatologist as mortality can be as high as 10%.

We've talked about using topical corticosteroids for eczema – what

determines if they're high potency or low potency?

Potency is measure by the ability to induce vasoconstriction. If you want to achieve large differences in potency it's better to change the drug to another rather than to simply increase the concentration of the same: tachyphylaxis can occur so it is best to have an interrupted schedule with periods of time where they are not being used to maintain effectiveness.

One ever-changing topic is on the treatment of skin burns: the most recent evidence shows that silver sulfadiazine, which is (was?) used as a topical cream on burns, can actually delay skin healing. If you do still use it, remember that it can't be used in patients with sulfa allergies and causes a theoretical stain so should not be used on the face.

- Seborrhoeic Dermatitis
 - ▶ Dry peeling of the scalp closely related to dandruff
 - ▶ Thick yellow crusty scalp rash in newborns ('cradle cap')
 - ▶ Treatment: anti-fungal shampoo applied to the area and left on for 2 minutes (ketoconazole) twice weekly



Everything you ever wanted to know about **psoriasis** but were afraid to ask:

How to describe the lesions? Erythematous plaques with silver scales and nail pitting

Where is it most commonly seen? Extensor surfaces and symmetric on both sides

What is Auspitz's sign? Punctate bleeding spots that arise when psoriasis scales are scraped off

Treatment: Non-curative; topical corticosteroids, tar, UV light, methotrexate can help

A random fact which you may need to know, even though it has no clinical use: psoriasis is associated with an increased risk for stroke

- Lichen Planus is associated with hepatitis C and causes pruritic papules with an overlying white **lace-like** pattern; treatment is topical or intralesional corticosteroids



- **Dermatitis Herpetiformis** is an intensely pruritic rash associated with celiac sprue; treatment is a gluten-free diet and dapsone. Like celiac sprue, this is a lifelong condition that will require continuous treatment.



- **Pityriasis Rosea**
 - ▶ Herald patch: single salmon-colored lesion on trunk
 - ▶ Widespread eruption in a 'christmas-tree distribution' after 1-2 weeks
 - ▶ Treatment: antihistamines (symptomatic)



- **Angioedema** refers to edema of the dermis, subcutaneous tissue, mucosa, and submucosa. It typically refers to swelling of the face, mouth, or tongue, but can also refer to swelling elsewhere (the hands, for instance). Aspirin is the most frequent culprit, but ACE-inhibitors and NSAIDs are also classically associated. ARBs can cause angioedema but with less frequency than ACE- inhibitors. Treatment involves antihistamines, H2 blockers, corticosteroids, and epinephrine.
- **Hereditary angioedema (HAE)** is a rare autosomal dominant disease that occurs in about 2% of cases of angioedema. Patients typically present with the first attack in their second decade of life. Attacks last 2-5 days and are associated with edema as well as GI involvement (severe cramps, nausea, vomiting, diarrhea). Diagnosis is confirmed by checking complement levels during an acute attack; C4 levels will be low. Symptoms don't respond to treatment the way that other cases of anaphylaxis do.

How is ACE-inhibitor induced angioedema best managed?

This particular type of angioedema is due to the accumulation of bradykinin so the **standard therapy (epinephrine, steroids, and antihistamines) for allergic angioedema is usually ineffective**. Some case reports suggest that **FFP can be used** in severe situations as it contains kinase which degrades excess

bradykinin. Other studies, however, have shown risk of worsening the edema as FFP also contains kininogen (the precursor to bradykinin). In 2015, there was a trial showing that patients with ACE-inhibitor induced angioedema treated with **icatibant** (bradykinin receptor antagonist) had faster resolution of symptoms compared to therapy with steroids and anti-histamines. In 2016, a study compared icatibant with steroids, anti- histamines, and epinephrine and showed no difference in resolution of symptoms.

Bottom line: There are NO effective therapies – focus on providing supportive care and securing the airway

- **Erysipelas**

- ▶ Typically located on the face of infants or toddlers with a raised and well demarcated border
- ▶ Most common cause is Group A Strep
- ▶ Treatment: dicloxacillin, erythromycin



- **Erythema nodosum**

What does it sound like? Erythematous nodules. That's pretty much all you need to know.

What does it look like? Erythematous nodules.



Where are they located? Erythematous nodules. Kidding – just making sure you were reading. Well the pictures show they're on the tibia. And they're bilateral. And they look painful.

Why does someone get them? It can be an immunologic response to a systemic disease (inflammatory bowel disease for example)

- **Pyoderma gangrenosum**

Just like peanuts are not actually nuts and koala bears don't belong to the bear family, pyoderma gangrenosum is a misnomer - **it is neither infectious nor gangrenous!**

It starts as an inflammatory pustule that progresses to a painful ulcer with a violaceous border and purulent base and is **associated with underlying systemic disease** (inflammatory bowel disease)

Treatment is topical corticosteroids for local disease and systemic corticosteroids for 4-10 weeks if widespread



- **Ecthyma gangrenosum** is associated with **Pseudomonas** infection
 - ▶ Small area of edema progressing to painless nodular lesion with central hemorrhage and necrosis
 - ▶ Often seen in immunosuppressed patients



- Pyogenic granuloma is a skin lesion that may result from minor trauma. It is known to bleed easily as it is basically a collection of capillaries. If it does bleed, holding pressure or placing a suture is typically effective. It is particularly common in pregnant women and self-limited as it may resolve spontaneously after delivery.



A child sees his pediatrician and is diagnosed with pharyngitis. He's prescribed amoxicillin and after completing a seven-day course presents with a rash. Diagnosis?



Well, it could be 'amoxicillin rash' – this can present after the first dose or even up to a few weeks *after* finishing. It's not a true allergic reaction but looks like one. Rash starts on the trunk and spreads, becoming more confluent. Treatment: supportive.

It could also be erythema multiforme, which starts out as target lesions but becomes confluent and looks very similar. It typically follows an HSV infection but can be secondary to drugs such as penicillin. Treatment: supportive.



What is the difference between erythema multiforme minor and major?

Both cause target lesions seen on palms, soles, and extensor surfaces Both can be caused by things like HSV or medications (sulfa, penicillin, etc) The difference is that *erythema multiforme major has mucosal involvement*

- **Stevens-Johnson Syndrome (SJS) / Toxic Epidermal Necrolysis (TEN)**
 - ▶ This is a spectrum of disease with SJS being the less severe but still highly lethal form; in one sentence: diffuse epidermal necrosis and detachment.
 - ▶ These conditions are most often drug-induced; commonly implicated drugs include allopurinol, sulfa, penicillin, and phenytoin among others.
 - ▶ A classic presentation would be an AIDS patient taking sulfa prophylaxis.
 - ▶ Early symptoms include fever and flu-like symptoms, followed by formation of blisters on the skin. Mucous membranes *are* involved.
 - ▶ SJS: skin sloughing in < 10% of BSA
 - ▶ TEN: skin sloughing > 30% of BSA (diffuse coalescing rash wherein the epidermis is actually separating from the dermis)
 - ▶ Treatment: early removal of the offending agent is key. Admit to an

ICU or burn unit and provide supportive care.



- **Staphylococcal Scalded Skin Syndrome**
 - ▶ Usually seen at *age 3-7 days*
 - ▶ Caused by *S. aureus* exfoliative toxins
 - ▶ Presentation: a febrile infant with diffuse blanching erythema often beginning around the mouth
 - ▶ Skin findings: fragile tense bullae that rupture on their own
 - ▶ + Nikolsky sign
 - ▶ *No mucous membrane involvement*
 - ▶ Treatment: IV penicillinase-resistant penicillin (nafcillin, oxacillin); replace fluids aggressively

What is the difference between Pemphigus Vulgaris and Bullous Pemphigoid?

Both are autoimmune diseases characterized by blisters that rupture Both *can* involve mucous membranes (but much less likely with Bullous) Both are treated with systemic corticosteroids and supportive care Pemphigus is the more severe form

Pemphigus has a + Nikolsky sign whereas Bullous Pemphigoid has a – Nikolsky sign



What is the difference between Pemphigus Vulgaris and TEN?

Vulgaris starts with individual blisters and doesn't have large coalescing areas

- Toxic Shock Syndrome
 - ▶ Classic presentation: a teenage girl presents with high fever, vomiting, diarrhea, muscle cramps, and a sunburn-like rash diffusely (can involve palms and soles). Despite IV fluids, she can develop skin desquamation and multi-organ failure.
 - ▶ Associated with *S. aureus* but blood cultures are almost never positive
 - ▶ Nearly 50% of cases are related to menses (from the use of fast-absorbing tampons instead of pads); other causes include nasal packing.
 - ▶ Symptoms develop rapidly in an otherwise healthy person
 - ▶ Treatment: supportive care and empiric antibiotics directed against *S. aureus*. Most importantly, remove the underlying cause.

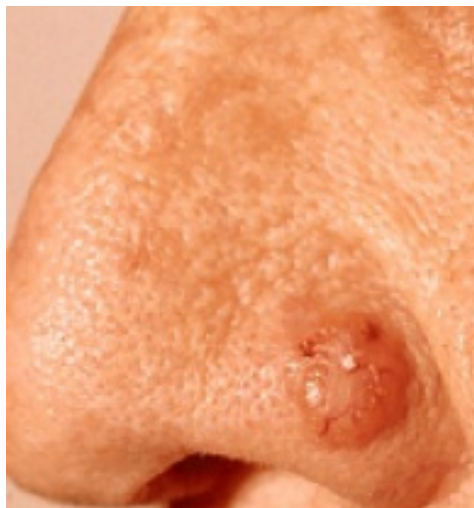
SKIN CANCER

Which of the following most increases the risk of someone developing basal cell carcinoma?

- A) Ethnicity
- B) Age
- C) Exposure to UV radiation
- D) Family history
- E) Coexisting medical conditions

Answer: C

Explanation: Basal cell carcinoma is the most common type of malignancy in caucasians and is rare in dark-skinned individuals. The number one risk factor is exposure to UV radiation in sunlight. Lesions have a pearly rolled border with central ulceration and are most often seen on the head and face. There is a low metastatic potential but it does place patients at higher risk to develop a different type of skin malignancy. Interestingly, basal cell carcinoma *can* recur after treatment.



- Squamous Cell Carcinoma
 - ▶ Can develop on any area of the skin
 - ▶ Fair-skinned individuals: more common in sun-exposed areas
 - ▶ Dark-skinned individuals: more common in non-sun-exposed areas
 - ▶ Typically has a central area of necrosis
 - ▶ Treatment: surgery, radiation



Marjolin's ulcer: type of squamous cell carcinoma that arises from a non-healing ulcer or burn

- Melanoma
 - ▶ Incidence increases with age
 - ▶ **Most important prognostic factor: *tumor thickness***
 - ▶ ABCDE – criteria used to help make the diagnosis:
 - ◆ Asymmetry
 - ◆ Borders irregular
 - ◆ Color variegated
 - ◆ Diameter > 6mm
 - ◆ Evolving lesion



FUNGAL INFECTION

Tinea Capitis: Scaly patches and pustules (kerion) that require treatment with oral medications

Tinea Corporis: aka 'Ringworm'; annular lesion with clear center that is highly contagious and treated with topical clotrimazole

Tinea Versicolor

- ◆ Hypo or hyperpigmented circular scaly patches
- ◆ Associated with *Malassezia furfur*
- ◆ Not contagious
- ◆ Treatment: selenium sulfide shampoo

Majocchi's Granuloma

- ◆ Caused by *Trichophyton rubrum*
- ◆ Dermatophyte infections are usually limited to the epidermis – however with trauma to the skin (from shaving for instance) the dermatophyte can pass into the dermis and cause subcutaneous nodules or abscesses
- ◆ Treatment: oral antifungals

INFECTIOUS

Which of the following is true regarding hidradenitis suppurativa?

- A) Most infections are polymicrobial
- B) Antibiotics and bedside incision/drainage is the definitive therapy
- C) It is characterized by chronic suppurative abscesses of the apocrine glands
- D) It is more common in the inguinal area

Answer: C

Explanation: Remember the 5 A's of hidradenitis. Hidradenitis is most often found in the **axilla** and is a chronic infection of the **apocrine** sweat glands. It is more common in the **African-American** population and surgery is the definitive therapy. *S. aureus* is the most common organism isolated.

- Gonococcemia
 - Disseminated gonococcus can produce one of two different syndromes:
 - 1) Tenosynovitis, dermatitis, polyarthralgia syndrome
 - ◆ Pinpoint petechial macules that progress to **vesicles or bullae**
 - Skin findings are most likely to occur on dorsal surface of distal extremities near joints and are self-limited

- ◆ Blood cultures and cultures from skin lesions are typically negative

2) Purulent arthritis without skin findings



- Infectious Endocarditis
 - ▶ Peripheral manifestations of endocarditis occur in only approximately 10% of patients – heart murmurs on the other hand are present in about 90% of cases
 - ▶ That being said, the ‘textbook’ pictures to know include subungual (splinter) hemorrhages, Janeway lesions (nontender maculae on the palms and soles), Osler nodes (tender subcutaneous nodules usually found on the distal pads of the digits), and Roth spots (retinal hemorrhages)

Let's say you're walking through a garden:



You see all the beautiful roses and decide to pick one. A few days later your arm looks like this:



What happened?!

You picked up sporotrichosis! Put down the rose and pick up some oral azoles or potassium iodide. Sporotrichosis is common in rose gardeners and animal handlers and causes cutaneous ulcers along lymphatic channels.

Tick bite and rash:



Lyme disease can be classified into 3 stages: early (localized), early disseminated, and late. Patients in the early (localized) stage have a target rash and may or may not have nonspecific symptoms. There's no point in serologic testing at this stage as it takes a few weeks for antibodies to develop so tests will be negative. Patients *should* be treated however, with 20-30 days of doxycycline (in general up to 14 days of doxycycline can safely be given to pregnant women – for Lyme, use amoxicillin). Early disseminated stage occurs weeks to months later; patients may have symptoms that are neurologic (meningitis or bilateral facial nerve palsy), cardiac (AV block), or musculoskeletal (severe monoarticular arthritis). **Serologic testing is indicated if the patient has evidence of disseminated disease.** Late stage lyme disease is most often associated with arthritis or neurologic symptoms.

In cases of tick bites, the likelihood of transmission is increased if the tick is engorged and/or has been attached for at least 72 hours

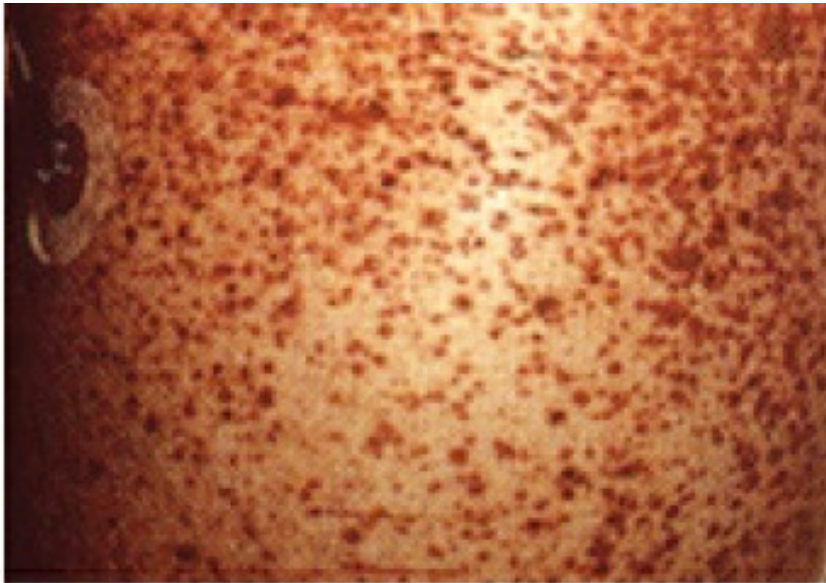
Tick bites are almost always treated with doxycycline or ciprofloxacin *For instance: Rocky Mountain Spotted Fever – caused by a tick bite that classically causes a petechial rash involving the hands and feet. Treatment?*

Doxycycline. Mind? Blown.

One exception! Tularemia is a tick-borne disease treated with IV streptomycin!

Treatment for children or pregnant women with RMSF is 14 days of doxycycline

- Meningococemia



- Cytomegalovirus (CMV)
 - * CMV mononucleosis has fever and systemic symptoms whereas EBV mononucleosis has pharyngitis and lymphadenopathy
 - ▶ Most neonates born with congenital CMV are asymptomatic at birth
 - ◆ Can lead to chorioretinitis, jaundice, hepatomegaly, deafness
 - ◆ Treatment: IV ganciclovir
- Varicella (Chicken Pox)
 - ▶ Fever, malaise, nonspecific prodrome
 - ▶ Lesions in **different stages of aging** (macular, papular, vesicular, crusted)
 - ▶ 5-15% of adult cases progress to pneumonia; treatment is IV acyclovir for seven days
 - ▶ Healthy children just need symptomatic care



- Herpes Simplex
 - ▶ HSV-1: oral lesions, corneal ulcers, stomatitis, fever
 - ▶ HSV-2: painful vesicles on genitalia and anus
- Herpes Zoster (shingles) is a varicella-zoster virus reactivation that causes painful vesicles in a dermatomal distribution; treatment: acyclovir

‘Disseminated zoster’ is involvement of three or more dermatomes, and may be a sign of immunocompromise

Which of the following would most benefit from being treated with oral fluconazole?

- A) A 25 year old female with a history of acid reflux and odynophagia
- B) A 3 month old baby with diaper rash
- C) A 55 year old male with dysphagia for solids and liquids
- D) A 30 year old male with odynophagia who is HIV positive

Answer: D

Explanation: Odynophagia in an HIV positive male should raise suspicion for esophageal candidiasis. This is an AIDS-defining illness and warrants treatment with oral fluconazole.

Let's take a break from dermatology for a moment...

Which of the following is *not* an AIDS-defining illness?

- A) Recurrent bacterial infections
- B) Cryptosporidium
- C) Pneumocystis jirovecii pneumonia
- D) Tuberculosis
- E) Kaposi's Sarcoma
- F) All are AIDS-defining illnesses

Answer: F

- Kaposi's Sarcoma is a neoplasm characterized by abnormal angiogenesis that produces purple or reddish skin lesions on the **lower extremities** often with lymphedema
 - ▶ Within the AIDS population it is seen more commonly in males who have sex with males



- ▶ Diagnosis: requires biopsy
- Flesh-colored, dome-shaped papules on the skin?



Molluscum Contagiosum

- ▶ Can be spread by sexual contact; considered an STD in certain cases
- ▶ Treatment: cryotherapy, curettage, podophyllotoxin
- Infectious Mononucleosis (EBV)
 - ▶ Fever, exudative pharyngitis, splenomegaly
 - ▶ **Posterior cervical lymphadenopathy is pathognomonic**
 - ▶ Complications: splenic rupture and thrombocytopenia
 - ▶ Treatment: supportive care and **no contact sports for at least 21 days**
 - ▶ Amoxicillin, if given, can cause a distinct maculopapular rash
- Occupational Exposure – needlestick injuries
 - ▶ HIV: the risk is increased in cases where the needle has visible blood contamination from being placed in the source's artery or vein. Overall risk is low but source patient should be tested. Postexposure prophylaxis (PEP) **should not be delayed for testing as the earlier it is started the more effective**. PEP can be stopped if source patient tests negative.
 - ▶ Hepatitis B: the risk is higher than with HIV or Hep C. Check the source patient for Hep B Surface Antigen (HBsAg). If the healthcare worker has received the Hep B vaccination, check their titers. **If their titers are low or they haven't completed the vaccine series, they should receive PEP if the source patient is HBsAg positive**. PEP consists of Hep B immunoglobulin and the

Hep B vaccine.

- ▶ Non-needlestick exposures
 - ◆ Pertussis: treatment after exposure is a Z-pak (azithromycin). PEP should be given to all household contacts.
 - ◆ Meningococcemia: PEP is a single dose of cipro 500mg or rifampin 600mg BID for two days

Speaking of exposures, let's take another break! With a question of course...

Bruce Whine wakes up and notices a bat in his room. He cries for his parents, who rush in and take him to the emergency room. Which of the following best summarizes his treatment?

- A) If there is no evidence of a bite, he can be discharged home safely
- B) Regardless of whether you see a bite, administer the rabies vaccine
- C) Regardless of whether you see a bite, administer the rabies vaccine to the whole family
- D) Regardless of whether you see a bite, administer the rabies vaccine and immunoglobulin

Answer: D

Explanation: CDC guidelines dictate that even if a child was bitten, the mark may be so small as to miss it. Therefore the mere presence of a bat in the room dictates that he should receive both the vaccine and immunoglobulin. Only those who were in the room with him at the time need to be treated as well.

Fifth's Disease – think Parvovirus B19!
Slapped cheek syndrome!



When else should I think of Parvovirus? Aplastic crisis in sickle cell patients!
What does it look like? An erythematous malar rash on days 2-5 of illness; facial rash is often followed by a reticulated or lace-like rash on trunk and extremities

- Hand-Foot-Mouth Disease: associated with coxsackie virus that causes lesions on the ... hand, foot, and mouth. It is highly contagious and can be transmitted even after symptoms have resolved. Treatment: supportive care.
- **Herpangina** is also associated with coxsackie virus; ulcers are isolated to the **soft palate and tonsils**. As opposed to **herpes gingivostomatitis**, where ulcers are found on the **soft palate and tonsils** but **ALSO on the gums, lips, or tongue**. With herpes, gingival hypertrophy is almost always present.





- Henoch-Schonlein Purpura (HSP)
 - ▶ Mnemonic to remember the major findings: ARENA
 - ◆ Abdominal pain
 - ◆ Rash: palpable purpura in gravity-dependent areas like the lower legs and buttocks. Importantly, the platelet count and coagulation factors will be normal.
 - ◆ Edema
 - ◆ Nephritis
 - ◆ Arthralgias/arthritis
 - ▶ Treatment: self-limited in most cases



- Kawasaki's Disease
 - ▶ Fever > 5 days plus at least 4 of the following: (CRASH)
 - ◆ Conjunctivitis
 - ◆ Rash (starts on palms and soles)
 - ◆ Adenopathy
 - ◆ Strawberry tongue
 - ◆ Hands and feet desquamation
 - ▶ Possible complication if left untreated: coronary artery aneurysm
 - ▶ Treatment: aspirin (high dose = 100 mg/kg), IVIG, +/- steroids
 - ▶ Prognosis is based upon the severity of coronary involvement as a marker of risk for MI
- Impetigo is a contagious superficial bacterial infection associated with *S. aureus* and *S. pyogenes* that produces painless honey-crusted lesions.

Treatment is dicloxacillin or mupirocin ointment.



- Scarlet Fever
 - ▶ Associated with Group A beta-hemolytic Streptococcus, and there is usually a preceding Strep infection (tonsillitis, pharyngitis)
 - ▶ Was a major cause of death before antibiotics came around
 - ▶ Symptoms: sore throat, fever, bright red “strawberry” tongue, rash
 - ▶ Diffuse erythematous rash with numerous small papules: ‘sandpaper rash’ that starts on head and neck and spreads down and to extremities



- ▶ “Pastia lines” are characteristic red streaks that form in the axillae and skin folds

Rubella (German Measles) vs Rubeola (Measles)

Triad for rubella: fever, rash, lymphadenopathy; “3 day measles”

Triad for rubeola: cough, coryza, conjunctivitis + Koplik spots

Koplik spots are pathognomonic but do not occur in all patients – they are small whitish or bluish elevations on an erythematous base described as ‘grains of salt on a red background’ that are typically seen 48 hours before the skin rash develops

Subacute sclerosing panencephalitis (SSPE) is a progressive degenerative disease of the CNS occurring 7-10 years after natural measles infection

- Roseola Infantum is associated with HHV-7 and HHV-8 and produces a high fever which resolves and is then followed by a rash
- Erythema Toxicum
 - ▶ Blotchy red spots with overlying white or yellow papules seen in almost 50% of term newborns; self-limited







ENDOCRINOLOGY

DISORDERS OF GLUCOSE

- Hypoglycemia
 - ▶ Symptoms of hypoglycemia depend on the glucose level *AND* the rate of decline
 - ▶ Symptoms: sweating, tremor, anxiety, nausea, dizziness, psychosis, coma
 - ▶ Always consider hypoglycemia in an unresponsive patient

Remember, beta blockers can mask the symptoms of hypoglycemia

The three mainstays of treatment for diabetes are metformin, sulfonylureas, and insulin

If a patient overdoses on **sulfonylureas** (ie glyburide), expect them to get hypoglycemic – with such a long half-life, patients may get *recurrent* hypoglycemia and therefore require ICU admission. The specific treatment is octreotide.

What about **metformin** ...

Which of the following lab findings would be expected in a metformin overdose?

- A) Anion-gap acidosis
- B) Non-anion gap acidosis
- C) Metabolic alkalosis
- D) Hypoglycemia
- E) Hypokalemia

Answer: A

Explanation: Metformin does not cause hypoglycemia – however it *can* cause lactic acidosis and hyperkalemia. The most important risk factor for metformin-associated lactic acidosis is decreased renal clearance. Diagnosis

is by clinical suspicion and definitive treatment is dialysis. Of note, neither the pH nor the lactate levels are predictive of survival. Remember to hold metformin for 48 hours in patients who receive IV contrast.

Too much **insulin** can obviously cause hypoglycemia, but the key is to differentiate between an insulinoma (insulin-secreting tumor of the pancreas) and an exogenous insulin overdose.

With insulinomas patients will have high insulin *and* C-peptide levels

Endogenous insulin has measurable C-peptide - exogenous insulin does not

If a patient is hypoglycemic and has high levels of insulin in their blood with low levels of C-peptide, consider an overdose of exogenous insulin.

Treatment of hypoglycemia:

- ◆ D50 if age > 8 (1-2 mL/kg)
 - ◆ D25 if age 1-8 (2-4 mL/kg)
 - ◆ D10 if age 1 (5mL/kg)
 - ◆ Glucagon 1mg IM/IV
 - ◆ Hydrocortisone (adrenal insufficiency)
 - ◆ Octreotide (sulfonylurea-induced, refractory to other treatment)
- ▶ **Glucagon** is strongly **contraindicated** in patients with **pheochromocytoma** – it can produce very high levels of catecholamines leading to hypertensive crisis. Glucagon stimulation test is actually used to help diagnose pheo: pretreat with an alpha blocker and give a dose of glucagon → check catecholamine levels at baseline and after two minutes and there will be a surge in patients with pheochromocytoma
- **Diabetic Ketoacidosis (DKA)**
 - * Pathophysiology: Since the hallmark of DKA is a deficiency of insulin, the body metabolizes triglycerides and amino acids instead of glucose for energy. This leads to a rise in free fatty acids. Glucagon also stimulates conversion of free fatty acids into ketones. Furthermore, high levels of glucose spill into the urine, bringing with

them extra water which precipitates dehydration and electrolyte depletion.

* What causes it?

- ◆ Medication noncompliance, infection, MI, trauma, any stressor
- ◆ Oral boards will often feature scenarios where patients are in DKA – if you forget to get an EKG, you'll miss the fact that there is a concomitant STEMI!

* Treatment?

- ◆ Fluids, fluids, fluids!

*** *Best way to determine if a patient is responding to treatment: normalization of anion gap and improving arterial pH – NOT lowering of the blood sugar* ***

- ◆ Replace electrolytes
 - ★ Insulin will further decrease potassium levels
 - ★ Cardiac arrest in DKA is often secondary to hypokalemia
 - ★ If potassium is > 5.5 , start treatment without potassium supplementation
 - ★ If potassium is $3.3-5$, give potassium along with insulin
 - ★ If potassium is < 3.3 , give potassium first, then start insulin and IV fluids
- ◆ Insulin drip (consensus is that there is no benefit to an insulin bolus before starting an insulin drip at 0.1 units/kg/hr)

An alcoholic patient presents with nausea, vomiting, and epigastric pain. Labs show an anion gap metabolic acidosis, but his pH is normal and serum ketones are negative. Does this patient have alcoholic ketoacidosis (AKA)?

The hallmark of AKA is an anion gap acidosis. The pH can be normal however as patients may have a mixed acid/base disorder due to vomiting or volume depletion. Lab tests for ketones measure acetoacetate, but the major ketone that's being produced is actually beta-hydroxybutyrate: causing a

potentially false negative serum ketone test.

- **Alcoholic Ketoacidosis**

- ▶ Binge drinking with heavy alcohol consumption and decreased food intake for several days (starvation ketosis)
- ▶ EtOH metabolism inhibits gluconeogenesis
- ▶ Symptoms: abdominal pain, nausea, vomiting, dehydration, disorientation
- ▶ Typically associated with a big anion gap – if the gap is not closing despite adequate resuscitation, consider co-ingestion with methanol or ethylene glycol (for instance)
- ▶ Treatment: thiamine, **dextrose** + saline, electrolyte replacement

Which of the following is true regarding hyperosmotic hyperglycemic nonketotic state (HHNS)?

- A) Patients have a lower mortality compared to those with DKA
- B) It occurs most often in patients with insulin-dependent diabetes
- C) Serum osmolarity is often > 350
- D) Administering insulin in this case is more important than additional IV fluids

Answer: C

Explanation: HHNS is characterized by much higher glucose levels, high serum osmolarity, and a lack of ketone production. It carries a higher mortality than DKA and the mainstay of treatment is also fluid resuscitation. It is more common in patients with NIDDM.

THYROID DISORDERS

- TRH from the hypothalamus stimulates the anterior pituitary to release TSH which in turn stimulates the thyroid gland to synthesize and release T3 and T4 (which then negatively feedback inhibit TSH release)
- T3 is the biologically active form of thyroid hormone
- Hyperthyroidism: the number one cause is Graves disease and signs include anxiety, tremor, insomnia, heat intolerance, weight loss, sweating, hair loss, tachycardia, palpitations, diarrhea, goiter, and exophthalmos
 - ▶ Labs: hyperglycemia, hypercalcemia, elevated liver function tests, low cholesterol
- **Pretibial Myxedema**
 - ▶ Rare manifestation of Graves disease that produces yellow waxy skin + bilateral firm dermal nodules/plaques which is an accumulation of mucopolysaccharides



What is the best initial treatment for a patient in thyroid storm?

- A) Antibiotics
- B) Propranolol
- C) Iodine
- D) Corticosteroids

Answer: B

Explanation: Thyroid storm is a life threatening complication of hyperthyroidism. Importantly, it is *not* directly related to the magnitude of excess thyroid hormone.

There is no lab test to distinguish hyperthyroidism from thyroid storm (in general TSH should be low and free T4 should be high) and thyroid storm is a clinical diagnosis. The hallmark presentation is CNS dysfunction, hyperthermia, and tachycardia out of proportion to the fever.

If you're asked about thyroid storm it's going to be about the treatment:

- 1 – Supportive care (tylenol can be given for fever but don't give aspirin – it facilitates conversion of T4 to T3)
- 2 – Propranolol blocks peripheral thyroid hormone effects
- 3 – PTU blocks thyroid hormone synthesis as well as the peripheral T4-T3 conversion. Methimazole is in the same class as PTU and while both can cause hepatotoxicity, PTU is considered worse.
- 4 – **Iodine can be given one hour after PTU** and blocks thyroid hormone release
- 5 – Corticosteroids may be beneficial

**** Don't forget about prophylactic broad-spectrum antibiotics! It's critical to treat the underlying cause of thyroid storm and infections are a frequent culprit. ****

Do you know about apathetic thyrotoxicosis? Do you care??? Haha!

Apathetic thyrotoxicosis is a rare type of hyperthyroidism seen in elderly patients characterized by weight loss, decreased appetite, lethargy, and slowed mentation.

This sure sounds like hyPOthyroidism...

Except patients may have a resting unexplained tachycardia. CHF and afib are common.

Thyrotoxic periodic paralysis (TPP) has [for some reason] been known to show up on exams. It is mostly seen in *Asian men* and characterized by abrupt onset of *hypokalemia* and *paralysis* secondary to *thyrotoxicosis*.

- **Hypothyroidism**

- ▶ Causes include: overtreatment of Grave's disease, dietary iodine deficiency, autoimmune destruction of thyroid (Hashimoto's), and side effect of medications (lithium, amiodarone)
- ▶ Signs: slowed mentation, AMS, psychosis, CHF, bradycardia, hypotension, pericardial effusion, puffy face and extremities (myxedema), loss of lateral third of eyebrows
- ▶ Treatment: levothyroxine (thyroid hormone replacement)

What should you know about myxedema coma?

It's a true medical emergency!

It's a misnomer – patients are not edematous or comatose. It can more accurately be referred to as 'decompensated hypothyroidism'.

Decompensation is typically due to infection and sepsis.

It's more commonly seen in women in winter months: cold and confused?
Think myxedema coma!

Signs include dry skin, prolonged relaxation phase of DTRs, nonpitting periorbital edema, and hyponatremia

Should treatment be with T3 or T4?

T3 is the biologically active form of thyroid hormone. Administering T4 has a lower risk of toxicity since it's a slow and delayed process before T4 can be converted to T3 and any clinical effect can be seen. This is the best approach in elderly patients or those with cardiac problems. For critically ill young patients, giving IV T3 is a reasonable choice, as long as you accept that there is a higher risk of arrhythmias.

Any other treatment pearls?

Before giving IV thyroid hormone, give hydrocortisone 100mg IV as adrenal

dysfunction can accompany decompensated hypothyroidism. Low blood pressure should be treated with fluids; pressors should be used with extreme caution. Don't warm patients too aggressively as it can increase risk for decompensation.

ADRENAL DISORDERS

- Cortisol is mostly involved in glucose regulation whereas aldosterone is involved in Na absorption and K excretion
- **Adrenal insufficiency**
 - ▶ The predominant manifestation of adrenal crisis is shock, but patients often have nonspecific symptoms such as anorexia, nausea, vomiting, abdominal pain, weakness, fatigue, lethargy, fever, confusion or coma

Hypotension typically fails to respond to standard resuscitative measures

- ▶ Patients with long-standing adrenal insufficiency may be hyperpigmented (due to chronic ACTH hypersecretion)
- ▶ **Primary Adrenal Insufficiency** aka Addison's disease
 - ◆ #1 cause is *autoimmune disease*
 - ◆ #2 cause is infectious (tuberculosis)
- ▶ **Prolonged administration of steroids** is by far the **most common cause** of ACTH deficiency and **secondary adrenal insufficiency**
- ▶ **Labs: hyponatremia, hyperkalemia, hypoglycemia**
- ▶ Don't wait for lab results if clinical suspicion is high
- ▶ Treatment: IV fluids and corticosteroids (**dexamethasone** is preferred - hydrocortisone, it does not affect the cortisol stim test)
- ▶ Mortality is most often due to shock or dysrhythmias (hyperkalemia)

- **Cushing's Syndrome (hyperadrenalism)**
 - ▶ Excess cortisol due to either prolonged steroid use, an adrenal neoplasm, or an ectopic ACTH-secreting carcinoma (like small cell lung cancer)
 - ▶ Signs: truncal obesity, HTN, hirsutism, edema, hypernatremia, moon facies, buffalo hump, purple striae
 - ▶ Treatment: stop steroids, treat the underlying cause
 - ▶ Diagnosis: dexamethasone suppression test

Which of the following is an expected finding in someone with SIADH?

- A) High serum osmolarity
- B) High urine osmolarity
- C) Hypernatremia
- D) Hypoglycemia
- E) Hyperkalemia

Answer: B

Explanation: ADH increases water reabsorption, so is normally secreted when the body is in a state of dehydration – SIADH is an inappropriate over-secretion of ADH leading to overly concentrated urine, low serum osmolality, and normovolemia. Neoplasm is the most common cause (small cell lung cancer).

	Serum Na ⁺	Serum Osm	Urine Osm
SIADH	Decreased	Decreased	Increased
Diabetes Insipidus	Increased	Increased	Decreased
Dehydration	Increased	Increased	Increased

Diabetes Insipidus

Central: failure to secrete ADH

Causes: most often idiopathic; other causes include head trauma and

Nephrogenic: normal ADH secretion but renal *resistance* to ADH

neoplasm

Causes: lithium toxicity,
hypokalemia, hypercalcemia,
nephrotoxic drugs

- ▶ Urinalysis shows dilute urine in the face of hyperosmolar serum

There's a lot of information on pheochromocytomas, but here are the basics:

Classic triad: episodic headache, sweating, and tachycardia

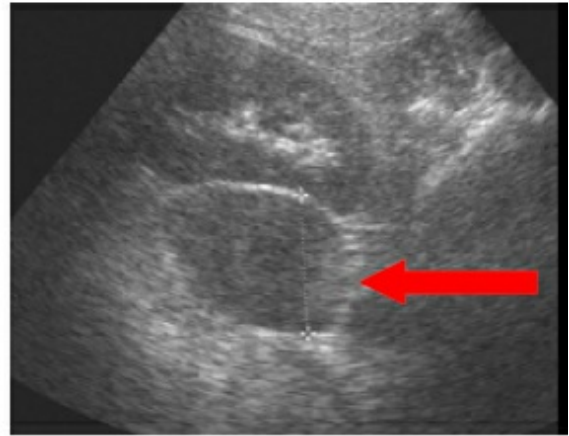
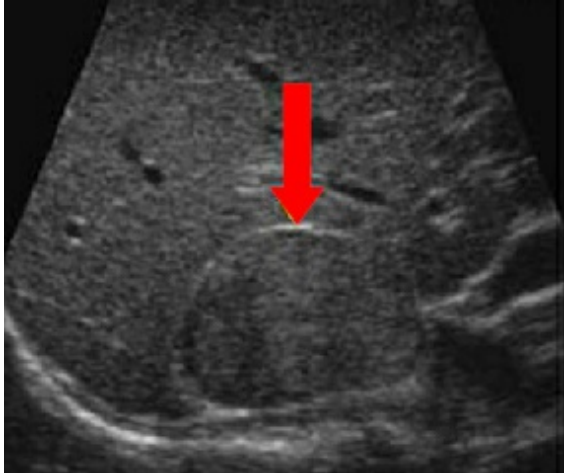
Scenario: young-ish patient with headaches, palpitations, and diaphoresis who has poorly controlled hypertension

With more widespread use of imaging studies, many are diagnosed as incidental findings on CT scan

Best initial screening test: 24 hour urine for catecholamines and metabolites

Once a **pheochromocytoma** is diagnosed, **all patients should undergo a resection** of the pheochromocytoma following appropriate medical preparation (controlling BP)

This is how they'll ask the question: in a patient with a pheochromocytoma, which of the following drugs is best suited to treat their blood pressure? You may be given a choice of beta blockers, diuretics, ACE inhibitors, etc Alpha blockers like phenoxybenzamine are considered first-line treatment. Other alpha blockers like doxazosin or terazosin can be used. Once alpha blockade is established, beta blockers can be added on.



ELECTROLYTE AND ACID/BASE DISORDERS

Hyponatremia

Symptoms depend on the level *and* the rate of decline – a level below 120 is considered critical

Classification:

- Hypovolemic hyponatremia
 - ▶ Patients appear clinically dehydrated; treat with IV fluids
- Hypervolemic hyponatremia
 - ▶ Decreased free water excretion; treat with IV fluids and loop diuretics
- Euvolemic hyponatremia
 - ▶ Treatment is mostly fluid restriction (+/- loop diuretics)
 - ▶ Examples include SIADH and psychogenic polydipsia

Hyperlipidemia and hyperglycemia cause pseudohyponatremia

Hyponatremia that develops slowly should be corrected slowly

Central pontine myelinolysis: irreversible neurologic disorder from overly rapid correction of severe hyponatremia

Patients with hyperacute hyponatremia that developed over a few hours due to a marked increase in water intake (like marathon runners, patients with primary polydipsia, etc) are not as susceptible to CPM and can have their levels corrected more rapidly

In patients with severe neurologic symptoms (seizures, altered mental status) up to 100cc of 3% hypertonic saline can be given over one hour.

Hypernatremia

Typically due to unreplaced water that is lost from the GI tract or skin. Excessive water loss rarely leads to hypernatremia however, as the resulting increase in plasma osmolality it stimulates thirst, which leads to increased intake of fluids and correction. Thus, in patients who have access to water, hypernatremia primarily occurs in those who are unable to sense thirst or respond to thirst normally. This is most commonly seen in infants and in adults with impaired mental status.

Maximum rate of correction is 12mEq per day (aim for 0.5mEq/hour)

Hypokalemia

Symptoms: muscle weakness, cramps, respiratory muscle weakness

Classic EKG finding: **U waves**; these are *not* specific for hypokalemia

Treatment: pain and phlebitis can occur during IV infusion of potassium into a peripheral vein (at rates > 10/hour) – it can be given faster using a central line

What you need to know:

1. For refractory hypokalemia, check a magnesium level
2. Be aware of 'hypokalemic periodic paralysis' – an autosomal dominant disorder that typically begins in adolescence and can lead to periodic episodes of mild weakness ranging to full body paralysis.

Hyperkalemia

Most common cause: lab error (ie hemolysis): the first step is to repeat the level

Classic EKG findings: **peaked T waves, increased PR interval, flattened P waves, prolonged QRS interval**

Treatment: calcium gluconate to stabilize the cardiac membrane for any case with EKG changes, insulin/D50, beta agonists, sodium bicarbonate – all work by shifting potassium from extra to intracellular. Theoretically, patients on digoxin with high potassium levels should not be given calcium as it can cause 'stone heart'. This has mostly been debunked but it's still something to be aware of.

Teaching point: kayexalate is an exchange resin and is the only treatment that will actually remove extra potassium from the body (other than dialysis); the FDA added a warning in 2009 indicating a risk for intestinal necrosis if given with sorbitol

Hypercalcemia

The number one cause is hyperparathyroidism

Symptoms: stones, bones, groans, psychiatric overtones (kidney stones, bone pain/fractures, abdominal pain/nausea, altered mental status)

Classic EKG finding: **shortened QT interval**

Teaching point: the most common renal manifestation of hypercalcemia is polyuria, due to a defect in concentrating ability. This can lead to

dehydration.

Treatment: IV fluids, calcitonin, cautious use of loop diuretics, dialysis as a last resort

Hypocalcemia

Causes: hypoparathyroidism (from post-surgical removal of the parathyroid glands), renal failure, vitamin D deficiency, pancreatitis

Signs: tetany, which may be mild (peri-oral numbness, paresthesias, muscle cramps) or severe (carpopedal spasm, laryngospasm, seizures)

Classic EKG finding: **prolonged QT interval**

Teaching point: Chvostek's sign is contraction of the ipsilateral facial muscles elicited by tapping the facial nerve just anterior to the ear.

Trousseau's sign is carpopedal spasm after inflating a BP cuff above systolic blood pressure for three minutes.



Treatment: calcium gluconate and magnesium

Always 'correct' a low calcium level!

Corrected Ca = Serum Ca + (0.8 x [Normal albumin – Patient albumin])

Thankfully, it's not as complicated as it looks...

If a patient's Calcium level is 6 and albumin is 3, then corrected calcium level is:

$6 + (0.8 \times [4-3])$ where '4' is always a normal albumin level. So the corrected level would be 6.8!

Hypermagnesemia

Symptoms: hyporeflexia, weakness, respiratory depression, heart blocks

Treatment: IV calcium, dialysis

The classic exam question involves a patient with preterm labor who is receiving magnesium to slow down contractions. This is why reflexes are monitored in these patients, as diminished reflexes will be the earliest sign of elevated magnesium levels.

Hypomagnesemia

Frequently seen in malnourished patients and in alcoholics Treatment: IV magnesium replacement

Teaching point: learning about electrolytes is sometimes very boring

Keep these straight for the exam:

Metabolic acidosis + hypokalemia = diarrhea

Metabolic acidosis + hyperkalemia = renal failure

Metabolic alkalosis + hypokalemia = vomiting (losing all the stomach acid)

Serum osmolarity

- Serum osmolarity is a lab result that is routinely given as part of the BMP
- You can also *calculate* a serum osmolarity: $(2 \times \text{Na}) + (\text{Glucose} / 18) + (\text{BUN} / 3)$
- The difference between measured and calculated of > 10 is an osmolal gap and indicates something else is present in the serum
- An osmolal gap indicates the presence of some other, unmeasured, low

molecular weight solutes (be it ethanol, ethylene glycol, isopropanol, methylene glycol, mannitol, etc)

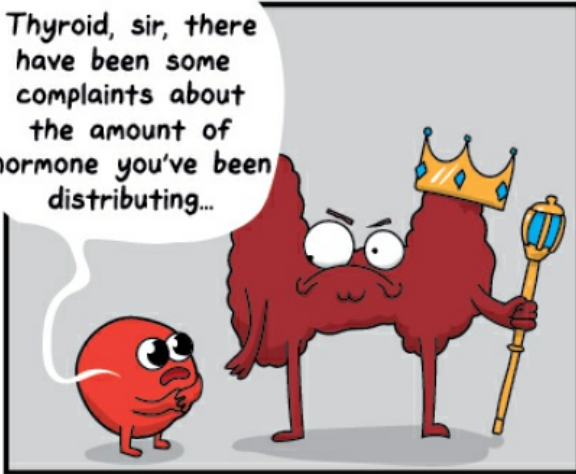
Rhabdomyolysis

This is one of those topics that comes up frequently – whether it is in clinical practice or on an exam. Have a good understanding of rhabdo.

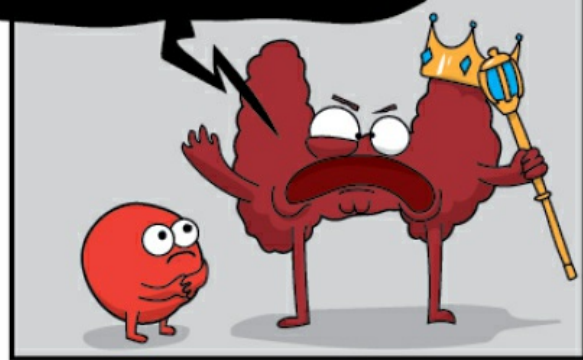
- ▶ The most sensitive test for diagnosis: CPK (at least 5x the upper limit of normal)
- ▶ Labs might show: Metabolic acidosis, hyperkalemia, hyperphosphatemia, hypocalcemia, hyperuricemia
- ▶ Myoglobinuria is present in 50-75% of cases
- ▶ Urine dipstick will test positive for blood, but urine micro will be negative for RBCs
- ▶ Patients with rhabdo are at risk to develop heme-induced kidney failure
- ▶ Treatment: IV fluids! Urinary alkalization with sodium bicarbonate is controversial but can be considered if the CK is really high and the urinary pH is really low (<6.5). Mannitol should be avoided.

Hyperthyroidism

Thyroid, sir, there have been some complaints about the amount of hormone you've been distributing...



SILENCE!

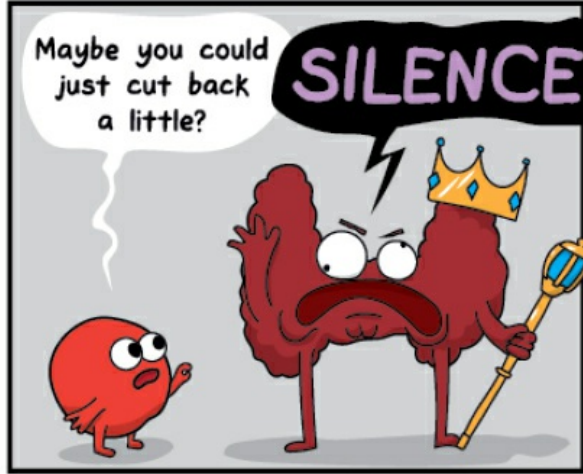


MY REIGN WILL BE KNOWN FOR ITS LEGENDARY PRODUCTIVITY!



Maybe you could just cut back a little?

SILENCE!





DISORDERS OF THE EAR

Hearing loss is divided into two main categories:

- **Sensorineural** hearing loss
 - ▶ Sudden onset sensorineural hearing loss (SSNHL) is a true medical emergency. Most cases are unilateral but if bilateral, consider brainstem infarction and image appropriately. All cases need ENT referral.
 - ▶ Treatment: steroids (typically a two week taper)
- **Conductive** hearing loss
- There are a number of causes of hearing loss: ototoxic medications (such as loop diuretics, salicylates, and aminoglycosides), infection, trauma, barotrauma, Meniere's disease, schwannoma, stroke, migraines, etc

A 16 year old wrestler presents after...well wrestling. He has ear pain and this is what you see:

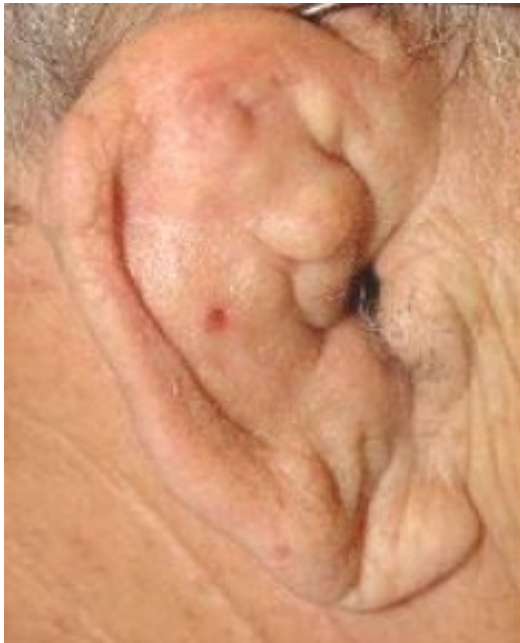


Looks like an auricular hematoma...are you going to send him home with pain meds and antibiotics? Sounds like a good plan...assuming he wants to

be a vegetable.

Auricular hematomas typically follow blunt trauma during sports (eg, amateur wrestling, rugby, boxing). Treatment is *prompt drainage* and prevention of reaccumulation of blood. Give antibiotics (like cipro) to cover for *Pseudomonas*.

If left undrained, patients can develop...cauliflower ear



A permanent deformity caused by fibrocartilage overgrowth that occurs when an auricular hematoma is not fully drained.

Auricular hematomas > seven days old should be referred to ENT

Hematomas <2 cm in diameter and present for up to 48 hours can undergo needle aspiration rather than incision/drainage

- **Tympanic Membrane Perforation**

- ▶ Causes:

- ◆ Barotrauma (unequal pressures on either side of the membrane, can result from eustachian tube dysfunction)

- ☆ High altitude (gas expands), increased internal TM pressure

- ★ Low altitude (diving), increased external TM pressure
- ◆ Trauma: blunt or penetrating (from a q-tip for instance)
- ◆ Noise, lightning, infections
- ▶ Patients present with hearing loss and pain
- ▶ Treatment:
 - ◆ Most heal spontaneously and do not require antibiotics
 - ◆ Patients should avoid getting any water in the ear
 - ◆ Systemic or topical antibiotics are generally not required unless perforation is due to infection or forceful water entry (water skiing for instance)



- **Otitis Externa**

- ▶ Inflammation of the external auditory canal
- ▶ Risk factors:
 - ◆ Swimming or other water exposure
 - ◆ Trauma from excessive cleaning can create abrasions allowing organisms to enter
 - ◆ Devices that occlude the canal such as hearing aids or headphones
- ▶ Most common pathogen is *Pseudomonas* followed by *S. epidermidis*
- ▶ Treatment: topical antibiotics with steroids (cipro-dex)
 - ◆ Cortisporin SUSPENSION (not solution) = neomycin/hydrocortisone



Malignant otitis externa is a severe and potentially fatal complication that is more common in diabetic and immunosuppressed patients and usually caused by *Pseudomonas*. Patients will have pain out of proportion to exam findings and may have cranial nerve findings (typically CN VII). Treatment is ciprofloxacin for 6-8 weeks; all unwell patients should be admitted and even well-appearing patients must have ENT followup in 12-24 hours.

Otitis Media (OM)

Symptoms? Otalgia and hearing loss

Physical exam? **Most sensitive finding: impaired mobility of the TM; most specific finding: bulging of the TM**

Etiology? ***S. pneumoniae* is the most common cause** (not Mycoplasma)

Variants? Bullous myringitis is a presentation of OM in which painful blisters or bullae are seen on the TM. Classically associated with mycoplasma infection although studies have shown that the same organisms that cause otitis media typically cause bullous myringitis



Do all children with otitis media need antibiotics? In 2013 the AAP published more stringent guidelines for antibiotic use: children at least 6 months of age with severe otitis media ('severe disease' is defined as moderate to severe otalgia with fever $>39^{\circ}\text{C}$) and children age 6-23 months with nonsevere but bilateral otitis media. Otherwise children can be managed either with antibiotics or observation / follow- up.

Complications? **Most common complication: hearing loss**

Other complications? Mastoiditis can present with fever, posterior ear pain, and local erythema over the mastoid bone. The **most common cause of acute mastoiditis: *S. pneumo*** and **most common cause of chronic mastoiditis: *Pseudomonas***. Do a CT scan if mastoiditis is suspected; treatment is antibiotics and ENT consultation. If oral antibiotics fail, admit for IV antibiotics.

- Cholesteatoma
 - ▶ Abnormal growth of squamous epithelium in the middle ear and mastoid that can lead to conductive hearing loss
 - ▶ More than 90% of cases are unilateral
 - ▶ More common in patients with a history of recurrent otitis media and/or chronic middle ear effusions
 - ▶ Most require surgical treatment; there is a recurrence rate of more than 50% within five years of surgery



A 55 year old male presents with dizziness in which he feels like the room is spinning. Which of the following historical features should raise suspicion for a CNS tumor?

- A) Nausea
- B) Vertical nystagmus
- C) Sudden onset
- D) Symptoms reproduced/exacerbated by changes in position
- E) None of the above

Answer: B

Explanation: Central vertigo describes vertigo that originates from within the CNS. Common causes include hemorrhage, ischemia, CNS tumors, infection, and multiple sclerosis. Features of central and peripheral vertigo are given in the table below.

VERTIGO

	Central	Peripheral
Onset	Gradual	Sudden
Severity	Less intense, ill defined	Intense
Duration	Constant	Intermittent

Worse with movement	No	Yes
Associated with N/V	No	Yes
Nystagmus	Purely vertical, horizontal, or rotational and persists even with focusing	Usually mixed horizontalrotational and lessens with focusing of gaze
Hearing loss/tinnitus	No	May occur
CNS symptoms	Usually present	Usually absent

Still have a hard time keeping them straight? Here's a HINT about peripheral vertigo:

Horizontal-rotational nystagmus
Intermittent symptoms Nausea
Tinnitus/hearing loss

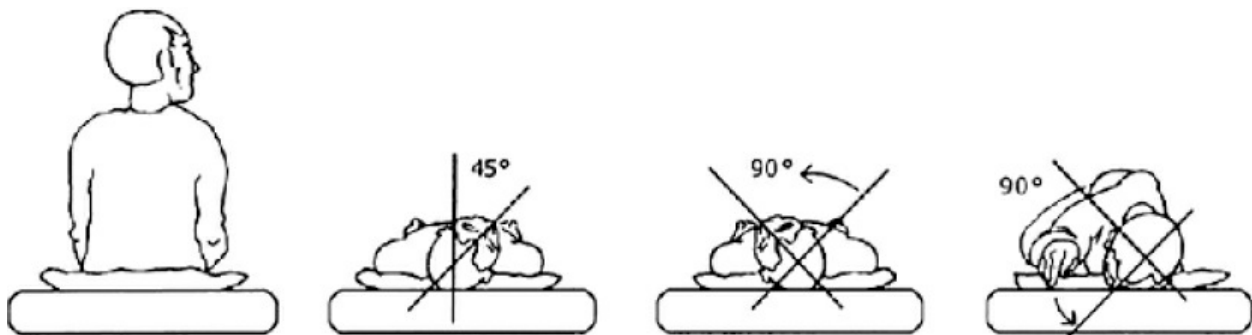
Benign Paroxysmal Positional Vertigo (BPPV) produces vertiginous symptoms that are worsened with head movement. Because it's a peripheral vertigo, symptoms are sudden in onset, can be very debilitating, and last a few seconds to minutes. Patients can get nauseated and don't have hearing loss or other neurologic findings. Most cases are idiopathic but potential causes include head trauma, infection, etc. The 'how' of how it happens is canalolithiasis - calcium debris within the posterior semicircular canal that can form because of impaired endolymphatic flow caused by clumped otoliths.

The *Dix-Hallpike* maneuver is *diagnostic*:



- Patient is in sitting position with head turned 45 degrees
- Lay the patient flat with their head hanging off the bed
- Observe for nystagmus
- If none noted, rest for 30 seconds and repeat to other side
- A positive test consists of nystagmus in the direction of the down side

The *Epley* maneuver can be *therapeutic*:



- Patient is in sitting position with head turned 45 degrees towards affected side
- Lay the patient flat with their head still turned 45 degrees
- Turn their head 90 degrees so the head is now 45 degrees to the opposite side
- Have the patient rotate their whole body 90 degrees so they are now on their side and hold this position for two minutes
- Other causes of Peripheral Vertigo
 - ▶ Vestibular Neuritis: **viral** or post-viral inflammatory disorder mostly affecting the vestibular nerve (balance); **rapid onset** of severe, persistent vertigo, nausea, vomiting, and ataxia

- ◆ Patients generally suffer from severe vestibular symptoms for one to two days, followed by a gradual improvement of symptoms and a return of equilibrium

Remember this:

In pure 'vestibular neuritis' auditory function is preserved - when hearing loss is present it is called 'labyrinthitis'

- ▶ Meniere's Disease
 - ◆ Triad of hearing loss, vertigo, and tinnitus
 - ◆ On an exam, you might be given the classic triad and asked to pick the diagnosis – be aware that Meniere's is also called 'idiopathic endolymphatic hydrops'
 - ◆ First-line treatment is a low-salt diet. If that doesn't work, thiazide diuretics may be beneficial.
- ▶ Acoustic Neuroma aka vestibular schwannoma
 - ◆ Slow-growing tumor in which the CNS has time to compensate, leading to less significant symptoms of vertigo
- ▶ Cerebellopontine Angle Tumors
 - ◆ Examples include neuromas, meningiomas, dermoids
 - ◆ Deafness, ataxia, ipsilateral facial weakness

DISORDERS OF THE NOSE AND FACE

Sinusitis

Symptoms are purulent nasal discharge, sinus tenderness, and maxillary or tooth tenderness

Do I need x-rays or a CT scan? Radiographs are not required for diagnosis

but CT scan is the test of choice when imaging is indicated (in cases of diminished visual acuity, diplopia, periorbital edema, severe headache, or altered mental status) When should I prescribe antibiotics? Patients with **symptoms < 10 days** duration should be **treated with supportive care** as the most common cause of sinusitis is viral. Beyond 10 days the IDSA guidelines recommend a 5-7 day course of amoxicillin-clavulanate for adults and 10-14 days of treatment in children.

Can it lead to anything bad? *Pott's puffy tumor* is a subperiosteal abscess associated with osteomyelitis of the frontal bone. Other complications include meningitis, brain abscesses, and cavernous sinus thrombosis.



One more thing to keep in mind: Recurrent sinusitis in a pediatric patient should raise suspicion for a nasal foreign body. Kids will often stick things into their right nostril and have runny noses, bloody noses, and congestion that gets misdiagnosed as sinusitis.

Which of the following statements is true regarding posterior epistaxis?

- A) Concern should be raised if, after placing bilateral nasal packing, blood continues to run down the oropharynx
- B) Most cases originate in Keisselbach's plexus

- C) Posterior bleeds are seen more commonly than anterior ones
- D) Anticoagulants more frequently cause posterior bleeds

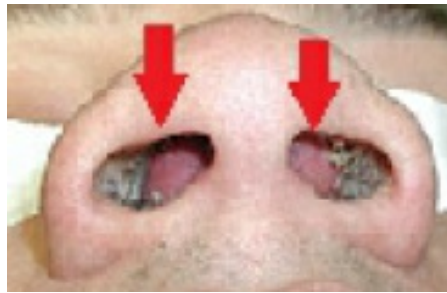
Answer: A

Explanation: Anterior nosebleeds are much more common than posterior ones. 90% of anterior bleeds are localized to Keisselbach's plexus where three primary vessels anastomose. Posterior nosebleeds can result in significant hemorrhage: most patients will need consultation with an ENT, and sometimes admission. The *sphenopalatine* branch is often involved. The best way to differentiate anterior from posterior epistaxis is to place bilateral packing anteriorly, and if the patient continues to have blood run down the oropharynx then suspect a posterior source. Interestingly, posterior bleeds are common in the elderly due to co-existing hypertension.

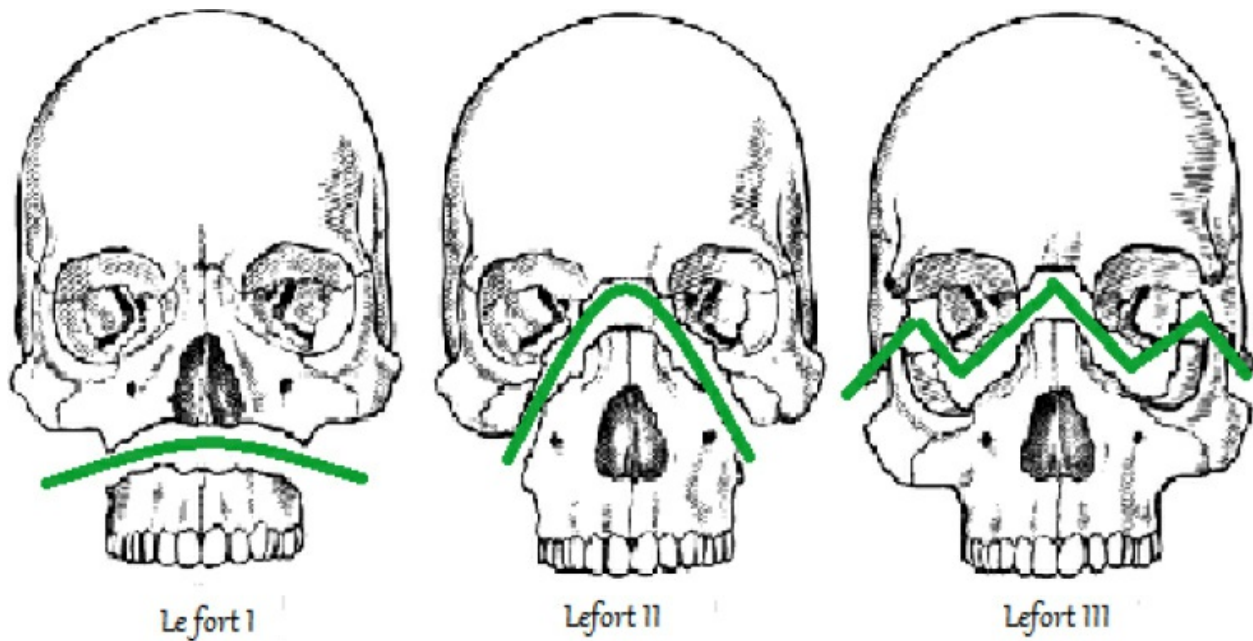


You don't need an x-ray to tell you he has a broken nose. Plain films are not indicated in the ER as it will not alter management – carefully examine the orbits and midface to rule out associated injuries. If it's an isolated nasal fracture, ENTs generally wait for 3-7 days to allow swelling to resolve before reducing them.

One thing to watch for is a **septal hematoma** which is associated with necrosis of the septum if left untreated and should be drained as soon as possible. Incise and remove the clot, pack for 2-3 days, and refer to ENT for packing removal. If you don't drain it, the patient can develop a saddle nose deformity: septal hematoma prevents blood from reaching the septal cartilage, leading to weakening of the septum and collapse of the nose.



- Mid-face fracture
 - ▶ Lefort classification:
 - ◆ I – Involves the hard palate (free floating upper alveolar process)
 - ◆ II – Extends to the orbital floor
 - ◆ III – Involves the zygoma and leads to craniofacial disruptionLefort II and III should raise concerns for airway compromise, C-spine injuries, CSF rhinorrhea, and malocclusion if diagnosis is missed
 - ◆ All extend through the posterior face and cause fracture of the **pterygoid plate**



DISORDERS OF THE THROAT AND MOUTH

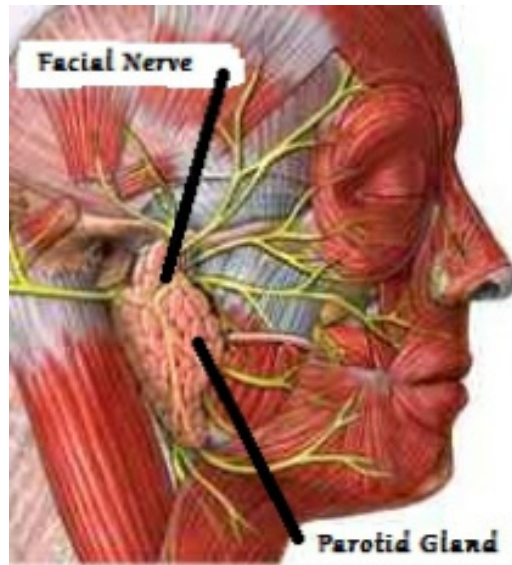
- Salivary Duct Stones
 - ▶ Presentation:
 - ◆ Pain and swelling in the involved gland; symptoms worsen with eating
 - ◆ Stones that intermittently obstruct can cause symptomatic episodes separated by days to weeks
 - ▶ Diagnosis:
 - ◆ Palpating the floor of the mouth (from posterior to anterior) is recommended to find a stone in the submandibular gland
 - ◆ Palpating the gland is important as well – normally very elastic but in this setting can be quite tender
 - ◆ Often seen on x-ray as calcifications; noncontrast CT is the test of choice

- ▶ Submandibular gland (aka 'Wharton's duct') is affected most often
- ▶ Risk factors:
 - ◆ Dehydration, diuretics, anticholinergics, smoking
- ▶ Treatment:
 - ◆ Patients should be instructed to keep well hydrated, apply heat to the involved area, massage the gland, and "milk" the duct
 - ◆ Sialogogues (lemon drops for instance) promote ductal secretions and can help
 - ◆ Discontinue use of anticholinergic medications such as benadryl and amitriptyline
 - ◆ Antistaphylococcal antibiotics such as dicloxacillin or cephalexin
- ▶ Sialadenitis
 - ◆ Pain, swelling, and erythema in the area of the gland, and with pus draining from the duct
 - ◆ May be associated with systemic symptoms such as fever

There is also a condition known as suppurative sialadenitis, or bacterial sialadenitis, which occurs in the absence of sialolithiasis. This typically affects the elderly, malnourished, or post-op patients. Patients are generally very sick.

Think of it as the 'acalculous cholecystitis' of the mouth – no stones, patients are very sick, and typically affects elderly and post-op patients

- Remember the close association of the facial nerve to the parotid gland – any lacerations to this area require close attention to surrounding anatomy



Parotitis: inflammation of the parotid gland, the major salivary gland

What can cause it?

1. Acute bacterial parotitis is most often caused by **S. aureus**
2. The most common viral cause is **mumps**, which is self-limited
3. Extra-pulmonary **tuberculosis** can affect the parotid glands
4. HIV parotitis – **HIV** can cause generalized lymphadenopathy but it can also cause localized enlargement of the parotid glands

Pharyngitis: The Centor criteria are a set of criteria designed to help make the diagnosis of Strep pharyngitis, with one point for each:



- Fever
- Sore throat with no cough

- Anterior cervical lymphadenopathy
- Tonsillar exudate

The “modified” Centor criteria takes age into account:

- 3-14 years old = add 1 point
- 15-44 years old = zero points
- > 44 years old = subtract 1 point

Scoring systems such as this can be helpful in identifying patients who are at such low risk that performing a throat culture or a rapid test may be unnecessary. However, to rely on such criteria to *make* the diagnosis is to misuse them. A rapid strep test is considered highly specific – in other words, patients with a positive test should be treated without waiting for a confirmatory culture. The sensitivity varies widely but is generally accepted to be 80-85%. In the old days (pre-2012) anyone with a score higher than 3 could be treated without any need for a rapid strep test or culture. However, the IDSA published new guidelines in 2012 which no longer recommended empiric treatment for patients based on a scoring system, finding that even patients with all clinical features of a scoring system were confirmed to have strep pharyngitis only 35-50% of the time.

Lots of debate on whether it's worth treating to prevent rheumatic fever but the fact remains: for testing purposes, you do

The likelihood of having Strep with 4/4 criteria is 55%; with 3/4 is 32%
Antibiotics are important to help prevent development of rheumatic fever

Antibiotics sound pretty solid – but you're not going to be asked which ones to use. The question will be: what treatment has been shown to have the greatest reduction in pain? The answer: Dexamethasone

A 20 year old male has fever, sore throat, and fatigue for one week. His oropharynx is red without exudate and he has cervical lymphadenopathy and splenomegaly. Rapid strep and mono tests are negative. What is the most likely diagnosis? Strep? Mono? Diphtheria? Other causes of viral pharyngitis?

It's most likely infectious mononucleosis. The mono test has a sensitivity of

70% in the first week of symptoms and 80% in the second week so a negative mono test in the first two weeks of illness really doesn't rule it out.

- **Infectious Mononucleosis**

- ▶ Most common etiology: Epstein Barr virus
- ▶ 90% of people have acquired immunity by the age of 40
- ▶ Symptoms are similar to Strep: sore throat, fever, fatigue, tonsillar exudate, **posterior** chain cervical lymphadenopathy
- ▶ Transmission is via saliva (therefore not considered very contagious)
- ▶ Diagnosis:
 - ◆ Presence of 50% lymphocytes with at least 10% atypical lymphocytes
 - ◆ The best test: **Monospot test** (ie heterophile antibody test). **Specificity is almost 100% but sensitivity is poor.** Especially poor in children, who never produce the heterophile antibody so they will almost always be negative.
 - ◆ Monospot test **can stay positive for up to one year**
- ▶ The virus will persist and lay dormant in the same cells for life
- ▶ Treatment:
 - ◆ If treated with amoxicillin (for presumed strep for instance), patients can develop a rash – this is NOT a true drug allergy. Keep in mind that the 'amoxicillin rash' can also happen after administering azithromycin, cephalosporins, or other antibiotics.
 - ◆ Athletes with mononucleosis must refrain from physical activity for a *minimum of 21 days*. At that point a repeat physical exam and possible abdominal ultrasound to assess for splenomegaly can be performed
- ▶ EBV-negative mononucleosis
 - ◆ ~ 10% of mononucleosis-like cases are not caused by EBV – other things to consider include CMV, HIV, Hepatitis B, toxoplasmosis

- **Ludwig's Angina**

- ▶ Polymicrobial cellulitis of the submandibular space that often follows a tooth abscess

- ▶ Rare in children and usually seen in people with poor dentition
- ▶ Patients present with swelling and pain in the submandibular area and in the floor of the mouth under the tongue
 - ◆ *Lymphadenopathy is characteristically absent*
- ▶ Treatment: timely diagnosis, airway management, and broad spectrum antibiotics



A 25 year old male presents with a complaint of fever, foul smelling breath, and painful swollen gums that bleed easily. How is this condition best treated?

- A) Penicillin VK
- B) Antimicrobial oral rinses
- C) Metronidazole
- D) Nystatin
- E) Fluconazole

Answer: C

Explanation: Acute necrotizing ulcerative gingivitis (aka 'Trench mouth' aka 'Vincent's angina') is associated with acute onset of fetid breath, blunting of the interdental papilla, and ulcerative necrotic sloughing of the gingiva. It is typically a polymicrobial infection with anaerobes frequently seen. Risk factors include immunosuppression, poor oral hygiene, and smoking. Treatment involves irrigation and debridement of necrotic areas, oral rinses, and antibiotics such as metronidazole in patients with systemic signs of illness (such as fever).



If an HIV patient presents with odynophagia, you should have a high suspicion for which of the following?

- A) Esophageal candidiasis
- B) Esophageal candidiasis
- C) Esophageal candidiasis
- D) Esophageal candidiasis
- E) All of the above

Answer: E

Explanation: Immunosuppressed patients are at high risk for developing esophageal candidiasis. In HIV patients it is considered an AIDS-defining illness. The only way to reliably diagnose is with endoscopy. **Treatment consists of 21 days of fluconazole.**

- Simple candidal infections present as white plaques on an erythematous base. Risk factors include the extremes of age, recent antibiotic use, immunosuppression, and use of steroids. Treatment ranges from topical nystatin to oral fluconazole.

- **Leukoplakia**

- ▶ *Precancerous* lesion that presents as white patches or plaques of the oral mucosa
- ▶ Particularly common in smokeless tobacco users
- ▶ **Cannot be scraped off (unlike candidiasis)**



- **Herpes Simplex Gingivostomatitis**

- ▶ Symptoms: fever and adenopathy (may precede lesions by three days)
- ▶ Physical exam: painful ulcers on gingiva and mucosa
- ▶ Secondary infection of lip lesions is common
- ▶ Treatment: acyclovir-like drugs can lessen severity and duration

- **Herpangina**

- ▶ Etiology: coxsackie virus
- ▶ Presentation: sudden onset high fever, sore throat, headache – followed by multiple oral vesicles that rupture and then develop into painful ulcers Physical examination:
 - ◆ Lesions on soft palate, uvula, posterior pharynx
 - ◆ Absence of lesions on buccal mucosa, gingiva, or tongue
- ▶ Highly contagious
- ▶ **Lasts 7-10 days, heals spontaneously**

- **Peritonsillar Abscess**

- ▶ Most common deep facial infection in adults
- ▶ Occurs most often in teenagers and young adults; rare in children < 12 years of age
- ▶ Presentation: fever, sore throat, trismus, “hot potato voice”, peritonsillar mass displacing soft palate and uvula
- ▶ Polymicrobial infection
- ▶ Diagnosis: imaging is not necessary, but if performed then CT scan with contrast is the test of choice
- ▶ Treatment: incision/drainage and antibiotics

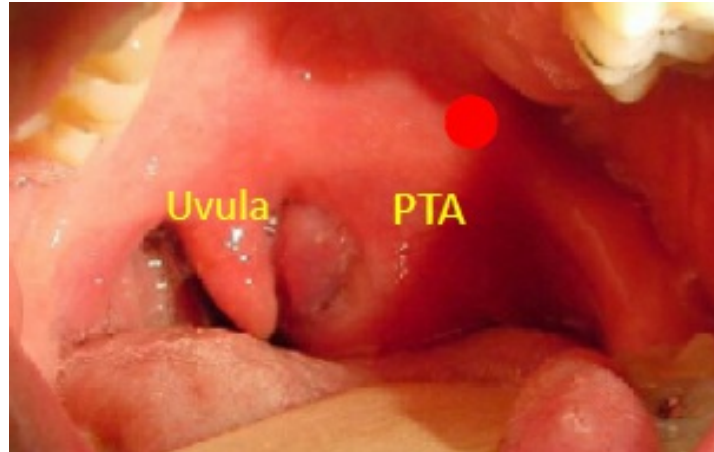
*An interesting complication that may be seen on a test is Lemierre’s Syndrome. It’s when a patient has pharyngitis or a PTA and bacteria spread from the abscess to the jugular vein – potentially causing thrombosis, septic emboli, and other bad things. Young healthy adults are usually the ones affected and present with high fever, lateral neck pain, and respiratory distress. The most common pathogen is *Fusobacterium necrophorum*.*

An intern is attempting to drain a peritonsillar abscess. He’s never done this before but he’s feeling confident because he watched a video right before gathering supplies. As his supervisor, you want to make sure he doesn’t enter the carotid artery. In which direction relative to the tonsil does the carotid artery lie?

- A) Medial and posterior
- B) Medial and superior
- C) Lateral and posterior
- D) Lateral and superior

Answer: C

Explanation: The carotid artery lies lateral and posterior to the tonsil. Try to avoid it.

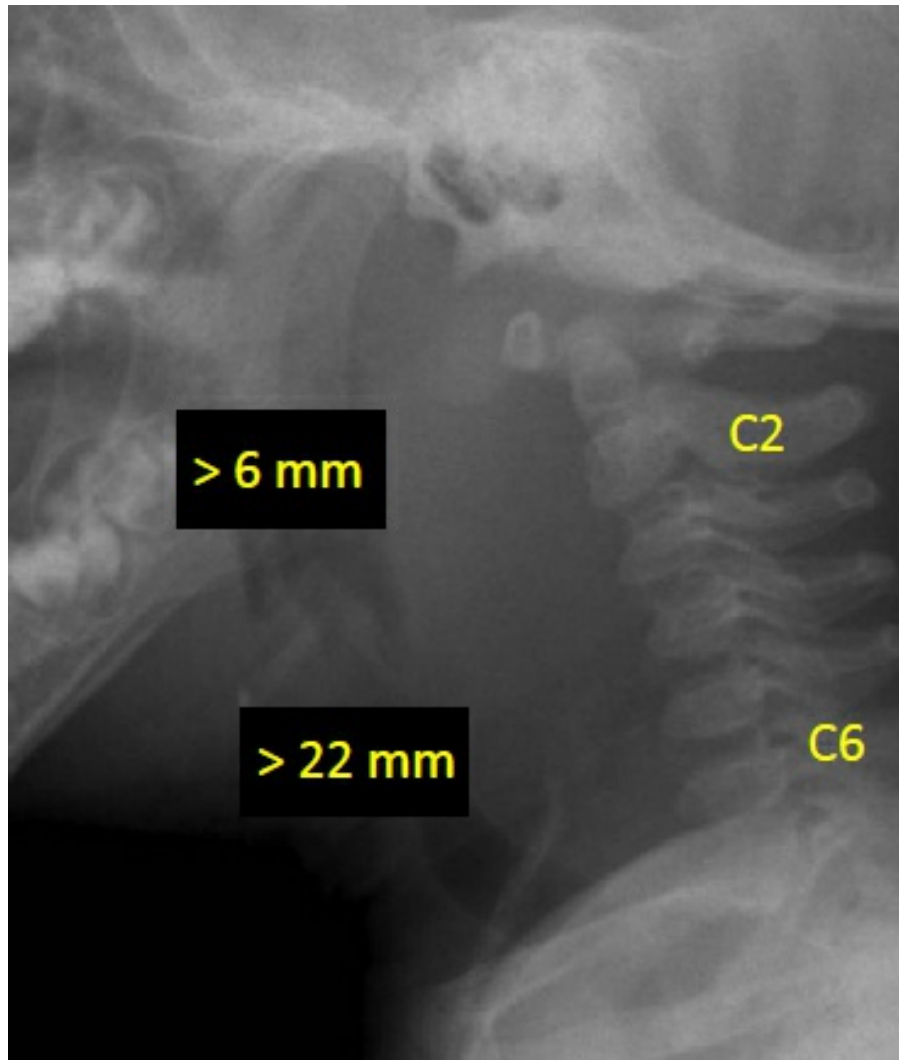


- **Retropharyngeal Abscess**

- ▶ More common in infants and young children as opposed to adults
- ▶ Polymicrobial infection
- ▶ Fever and sore throat are the most common presenting complaints
- ▶ Exam shows posterior pharyngeal edema
- ▶ Diagnosis: test of choice is CT scan with IV contrast but lateral neck plain films can be helpful as well
- ▶ Must distinguish from epiglottitis – usually progresses slower and symptoms can be present for several days before a diagnosis is reached
- ▶ Treatment: ENT consult for drainage and antibiotics

What are the criteria for diagnosis of retropharyngeal abscess on lateral neck plain film?

‘6 at 2 and 22 at 6’: soft tissue swelling more than 6mm at C2 and more than 22mm at C6



A patient presents with sore throat and fever. On exam you note anterior cervical lymphadenopathy and mild pharyngeal erythema with isolated spots of gray and white exudate. Which of the following is the antibiotic of choice?

- A) Penicillin
- B) Fluoroquinolone
- C) Aminoglycoside
- D) Third-generation cephalosporin

Answer: A

Explanation: Diphtheria is caused by *Corynebacterium diphtheriae*. It can be transmitted by either respiratory droplets or skin lesions (less severe). The

earliest findings on exam are mild pharyngeal erythema which can progress to isolated spots of gray and white exudate and ultimately pseudomembrane formation. Treatment of respiratory diphtheria is antibiotics and antitoxin for severe cases. Treatment of cutaneous diphtheria is antibiotics alone; antitoxin is not necessary given the lack of cardiac involvement. The antibiotic of choice is penicillin.

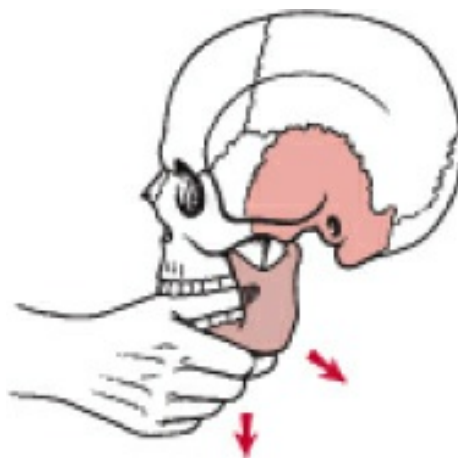
The severity of diphtheria correlates with the severity of membrane formation and NOT toxin production. Untreated, the diphtheria exotoxin can affect the heart (myocarditis), nervous system, and kidneys.

- **Epiglottitis**

- ▶ Etiology: *H. flu B* is the most common infectious cause and it is now considered more common in adults than children!
- ▶ Presentation:
 - ◆ Most cases present with sore throat and dysphagia (not stridor and drooling). This means it presents very similar to a peritonsillar abscess – but without the uvular deviation.
- ▶ Diagnosis:
 - ◆ The classic finding is a ‘thumbprint sign’ on plan film of the lateral neck, but the gold standard is visualization with nasopharyngoscopy
- ▶ If anything, you may be asked for the first step in management:
 - ◆ Early anesthesia and ENT consultation for airway placement
 - ◆ Next step: ceftriaxone is the antibiotic of choice
- ▶ Racemic epinephrine has been discredited and may actually cause harm



- Temporomandibular Joint Dislocation
 - ▶ Typically occurs by opening the mouth too wide (yawning for instance)
 - ▶ Most dislocations are anterior and bilateral so patients will present with an open mouth
 - ▶ In cases of unilateral dislocation, the jaw is rotated toward the unaffected side



Which of the following parts of the mandible is least often fractured?

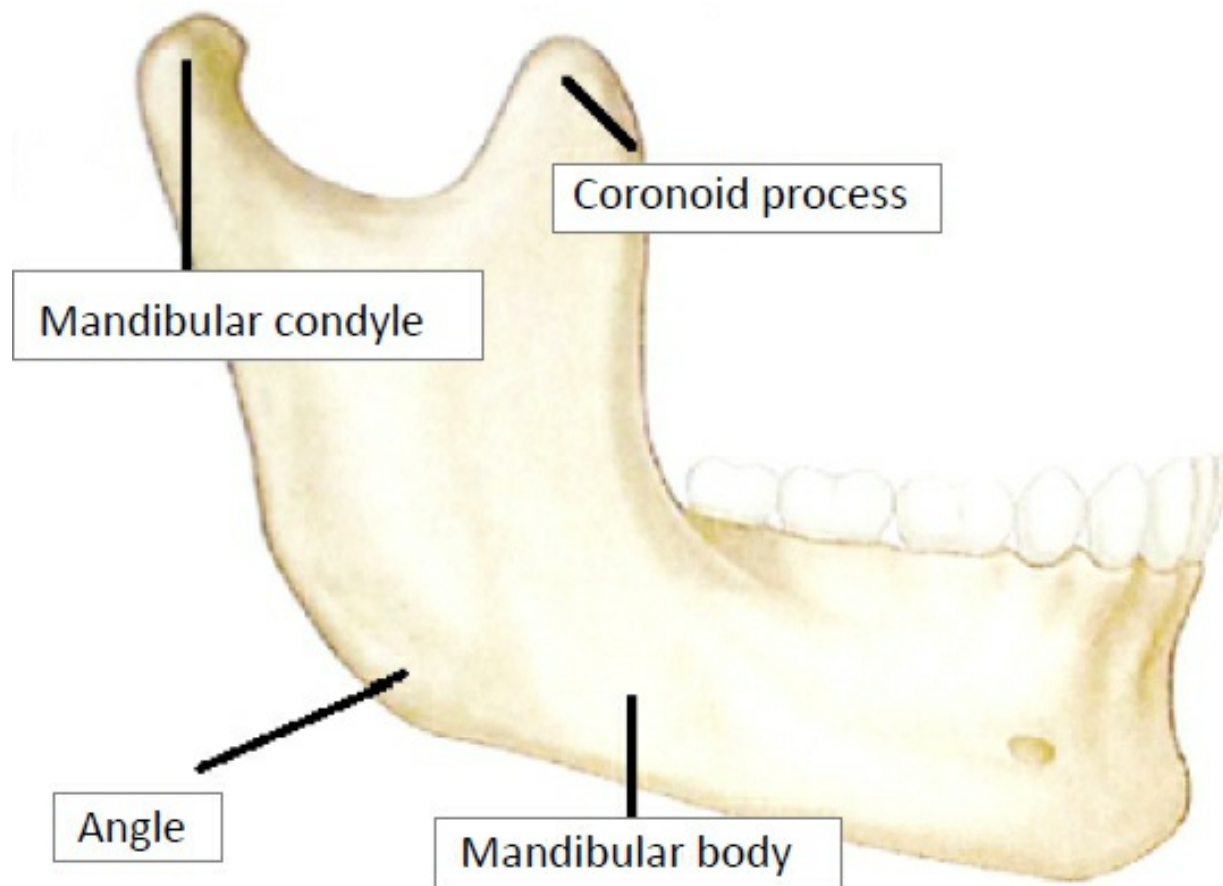
- A) Mandibular condyle
- B) Coronoid process

- C) Angle of the mandible
- D) Mandibular body

Answer: B

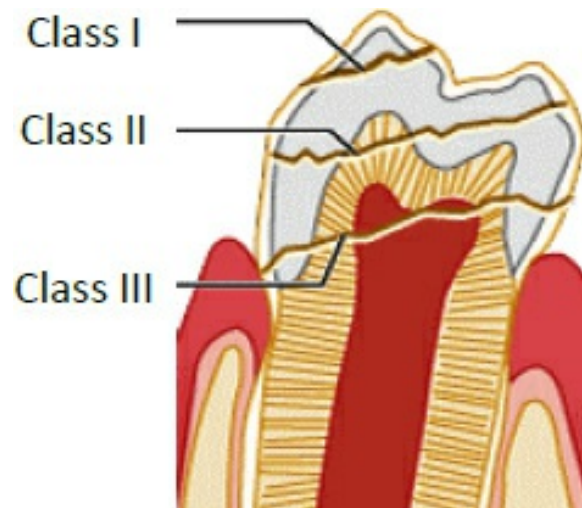
Explanation: Mandibular fractures most often occur in the *mandibular condyle* and least often in the coronoid process. Fractures typically occur at two or more locations because of the U-shaped bone. Signs of a mandible fracture include malocclusion, trismus, and deviation of the chin. A positive tongue blade test warrants imaging. The **presence of blood in the mouth suggests an open fracture** (necessitating use of antibiotics). Patients may also develop mental nerve anesthesia (chin/lip).

**** When a mandible fracture is suspected, a panoramic radiograph of the mandible is the least expensive and most accurate film to assess the patient ****



Fractured teeth are described by the Ellis classification:

Class I	Enamel	Refer for outpatient follow-up
Class II	Dentin	Cover dentin with calcium hydroxide paste and refer for follow-up
Class III	Pulp	Immediate dental consultation



Calcium hydroxide paste is the best way to cover a tooth fracture.

If a tooth falls out and it's an infant (primary) tooth, don't re-place it. Any other tooth should be replanted as quickly as possible. Make sure you rinse the fallen tooth and don't scrub it as this can damage the periodontal ligament. The best medium to hold an avulsed tooth is a pH-balanced cell-preserving solution such as Hank's Balanced Solution. It is better than milk or saliva (under the tongue)..

Which of the following is least likely to be associated with dry socket syndrome?

- A) Pain
- B) Gingival swelling
- C) Fever
- D) Lymphadenopathy

Answer: C

Explanation: Dry socket occurs 1-3 days after a dental extraction when alveolar bone becomes exposed due to an absence of clot over the socket. Pain is the most common complaint and is often refractory to oral analgesics. Lymphadenopathy and gingival swelling may occur, while fever and facial swelling often do not.

What is the treatment for dry socket syndrome?

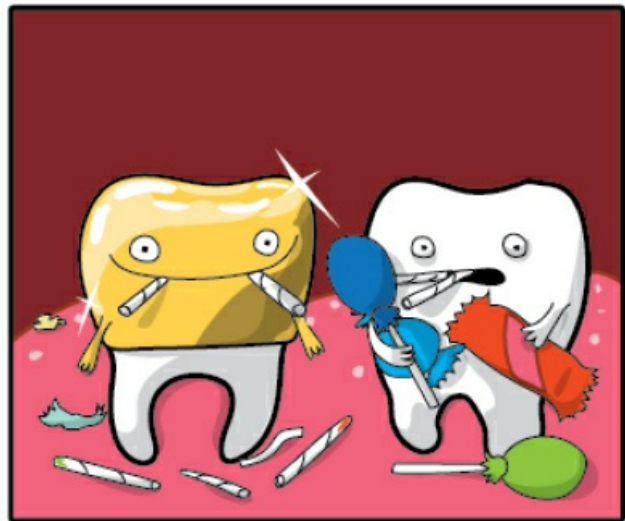
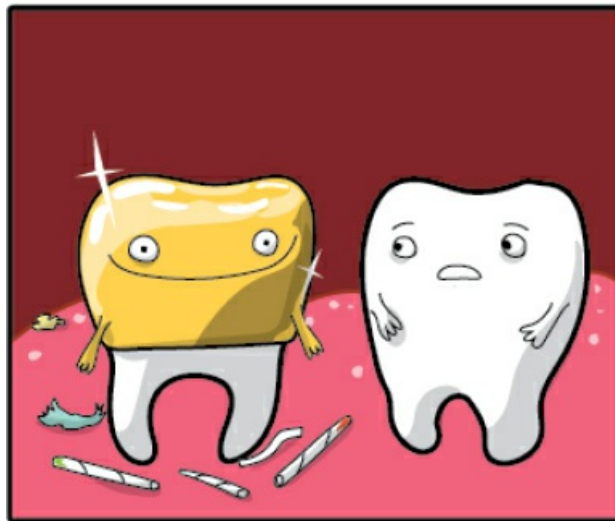
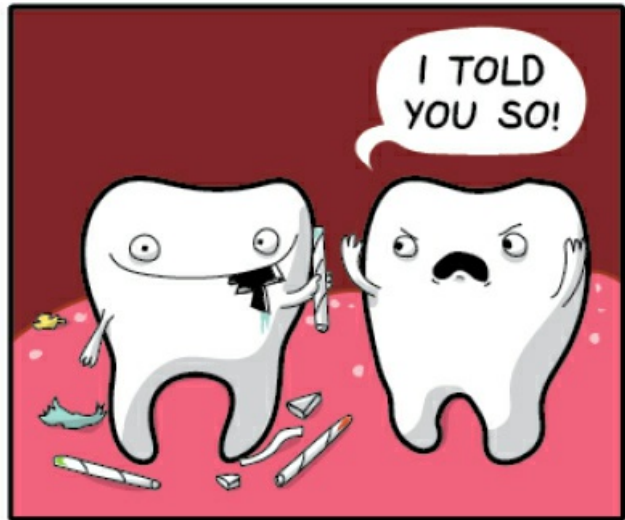
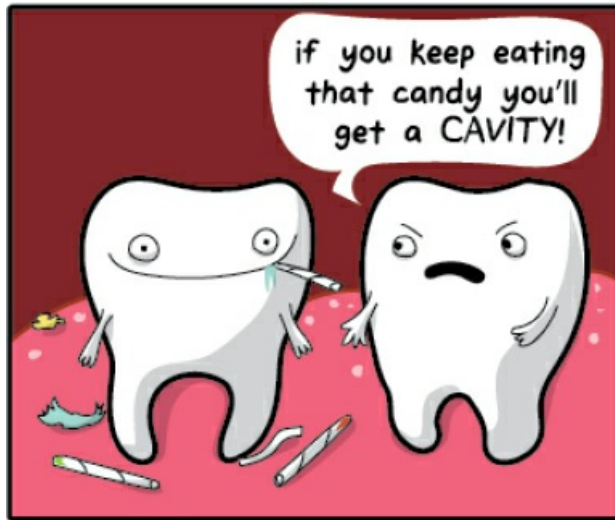
Analgesia and irrigate the socket gently with warm saline to remove any food particles or partial clot. Eugenol gauze or viscous lidocaine may be used to fill the socket; antibiotics are unnecessary unless there is concern for infection.

A patient presents to the ER after having a tooth removed earlier in the day. He is now having profuse bleeding from his mouth and cannot get it to stop despite holding gauze over the area where his tooth was removed. Which of the following is the first step to stop this post-extraction bleeding?

- A) Have the patient rinse his mouth with ice water
- B) Apply a topical pro-coagulant to the bleeding site
- C) Cauterization if a bleeding vessel can be visualized
- D) Inject 1% lido w/epi and have the patient bite down on gauze

Answer: D

Explanation: Excessive bleeding is a common complication following routine dental extraction. By the time the patient has presented they have typically already tried rinsing their mouth with ice water and possibly biting down on a tea bag to attempt hemostasis. The best initial step is to anesthetize the area with 1% lidocaine with epinephrine to try to stop the bleeding and have the patient bite down on gauze placed at the site of bleeding for at least ten minutes.





A 6 year old child jumped off a diving board. He stayed under water for 12 seconds and then resurfaced without any signs of respiratory distress. Which of the following terms best describes his situation?

- A) Dry drowning
- B) Wet drowning
- C) Non-fatal drowning
- D) Water rescue

Answer: D

Explanation: 'Drowning' by definition is the process of suffering respiratory impairment following submersion in a liquid medium. If the patient survives it is a 'non-fatal drowning', if they die it is a 'fatal drowning', and if there is submersion without any respiratory difficulties it is considered a 'water rescue'.

- **Non-fatal drowning**

Even though the patient survives they can aspirate! Leading to hypoxemia, noncardiogenic pulmonary edema, ARDS, arrhythmias (can occur secondary to hypothermia)

On the bright side, significant electrolyte imbalances generally do not occur

C- spine injury is uncommon in nonfatal drowning victims, unless there are clinical signs of injury or a concerning mechanism (ie a dive into shallow water)

- **'Dry drowning'**

This is a misnomer and not a truly accepted medical condition. Use of this term is perpetuated by the media and therefore persists but its use has been discouraged by ACEP and most other major voices in emergency medicine.

What it supposedly refers to is the process whereby a small amount of water enters the lungs, potentially causing laryngospasm. Patients may develop a

subsequent cough, difficulty breathing, chest pain, or vomiting. These symptoms might start as soon as the person exits the water or up to 24 hours later. Pulmonary edema or ARDS may eventually develop; treatment is supportive care.

Primary factor in any drowning survival is the duration of immersion The predominant cardiac arrest rhythm in drowning is asystole (not Vfib)

- **Scuba Diving**

Barotrauma is the most common form of diving-related *injury*

3 types of barotrauma to be aware of that can occur with scuba diving:

1) Air embolism

- ▶ What is it: air bubbles cross the alveolar-capillary membrane and move into circulation. They may be arterial or venous, potentially causing a wide range of symptoms (PE-like, MI-like, or stroke-like for instance).
- ▶ Scenario: a diver loses consciousness while ascending or within 10 minutes of surfacing
- ▶ Patients with PFO/septal defects are more susceptible
- ▶ Treatment: place in the left lateral decubitus position with Trendelenburg

2) Decompression Sickness aka Caisson's disease aka 'the bends'

- ▶ Like an air embolism, it's what happens when you ascend too quickly
- ▶ Length and depth of dive are the primary determinants of risk
- ▶ Symptoms include periarticular pain (shoulders and elbows are the joints most commonly affected), pruritis, erythema, and cutis marmorata (venous stasis); loss of consciousness is uncommon
- ▶ Symptoms might appear immediately but may occur up to 12 hours later. Delayed symptoms are common if air travel follows diving.
- ▶ Treatment: hydration, administration of 100% oxygen, and consider hyperbaric oxygen

3) Nitrogen Narcosis

- ▶ Unlike the others, this occurs the deeper you go: at depths > 100 feet
- ▶ Symptoms: anesthetic-like effect, impaired motor control, **loss of consciousness**
- ▶ **Divers recover rapidly upon ascent** to a shallower depth
- ▶ Can lead to impaired judgment which can lead to drowning accidents

The problem with boards is they expect you to have studied the above three so they probably won't ask you any questions about them. The scenario that may come up is a diver who holds his or her breath while ascending and is severely symptomatic upon surfacing. They present to the ED with normal vital signs and asymptomatic now other than some swelling or fullness in the neck. Options will include all of the above plus **pneumomediastinum**. They won't use the word 'crepitus' because that would be too fair, but that is what's implied.

Which of the following is most commonly injured following a blast injury?

- A) Lungs
- B) Liver
- C) Spleen
- D) Tympanic membrane
- E) Cervical spine

Answer: D

Which type of blast injury occurs when a person is thrown through the air and suffers injuries as a result?

- A) Primary B) Secondary C) Tertiary D) Quarternary

Answer: C

Explanation: Blast injuries are injuries resulting from direct or indirect exposure to an explosion. There are four classes:

- Primary: barotrauma; absence of external injuries
- Secondary: most casualties are caused by this type; damage from flying objects striking the body, penetrating trauma, and visible bleeding
- Tertiary: Some combination of blunt and penetrating trauma; patient's body flies through the air and lands
- Quarternary: All others (smoke inhalation, chemical exposure, etc)

High-altitude illness (HAI) is a collective term basically referring to any illness related to high altitude, including both **high altitude cerebral edema** (HACE) and **high altitude pulmonary edema** (HAPE). The best way to prevent any of these from occurring is gradual ascent – it's not a race to see who can get to the top first. Unless it is, in which case the top better have a lot of first aid kits. If any of these conditions occur, descent and supplemental O2 will almost always help.

"Climb high, sleep low":

Day trips to higher altitudes with a return to a lower altitude for sleep may accelerate acclimatization

‘**Acute mountain sickness**’ is the most common form of high altitude illness. Patients suffer from headache and other nonspecific symptoms and descent will pretty much fix it. If they continue to climb they'll develop ‘high altitude cerebral edema’ and begin suffering from ataxia, vomiting, confusion, seizures, and coma. HACE is rapidly fatal without prompt treatment. **Descent is the definitive treatment and should begin immediately at the first suspicion.** Steroids (dexamethasone) and mannitol can also be of benefit.

‘High altitude pulmonary edema’ on the other hand is the *most common cause of death among all the high altitude illnesses*. It begins with a nonproductive cough and shortness of breath and progresses to noncardiogenic pulmonary edema 2-4 days after rapid ascent. **Unlike HACE, immediate descent is not mandatory** and steroids/mannitol are not helpful.

First-line therapy is oxygen but **if supplemental O₂ is not available, then descent should begin as soon as HAPE is suspected.** PDE-5 inhibitors like sildenafil (Viagra) can also be helpful. Nitrates and diuretics should be avoided.

There are some anecdotal reports of HAPE patients presenting with infiltrates in the **right middle lobe**

Prophylaxis for HACE: acetazolamide (induces acidosis thereby increasing the respiratory drive)

Prophylaxis for HAPE: Nifedipine

Which of the following is typically associated with moderate hypothermia?

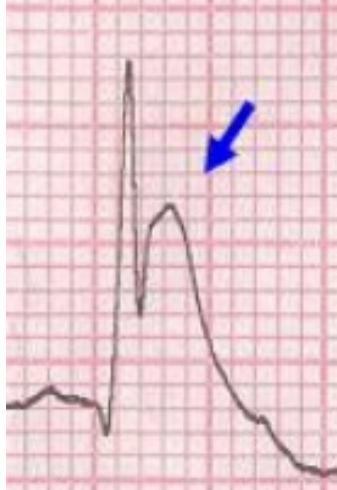
- A) Atrial fibrillation
- B) Shivering
- C) Unresponsiveness
- D) Absence of pulses

Answer: A

Explanation: Mild hypothermia is defined as 35°C down to 32°C. Moderate hypothermia is 32°C to 28°C and severe is any temperature less than 28°C. Shivering ceases at 32°C so will only be seen in cases of mild hypothermia.

Take a minute to review the classic EKG finding of hypothermia:

- Osborne waves are positive deflections and their height roughly correlates with the degree of hypothermia
- These waves are *not* pathognomonic for hypothermia and can be seen in other conditions



- Mechanisms of heat loss
 - ▶ Evaporation: when you sweat or get wet and that liquid changes to a vapor form promoting heat loss; important heat loss mechanism in hot environments
 - ▶ Radiation: majority of heat loss; heat generated from within the body is given off to the surrounding atmosphere
 - ▶ Conduction: increases significantly when wet; direct transfer of heat to an adjacent, cooler object – for instance staying still in water will preserve heat while moving around increases heat loss
 - ▶ Convection: direct transfer of heat to convective air currents
- Patients can develop bradycardia and atrial fibrillation
- External rewarming can be passive (for instance removing wet clothes or covering with a warm blanket) or active (Bair hugger)
- Internal rewarming includes warm humidified O₂, warm IV fluids, gastric or peritoneal lavage with warm NS, and extracorporeal bypass rewarming

Frostnip is reversible transient freezing; **Frostbite** is irreversible local tissue freezing

- Frostnip
 - ▶ Localized paresthesias that resolve with rewarming
- **Frostbite**
 - ▶ Classification

- ◆ 1st degree: Superficial, erythema, no blisters
- ◆ 2nd degree: Full thickness, clear blisters
- ◆ 3rd degree: Hemorrhagic blisters, skin necrosis
- ◆ 4th degree: Extends to bone
- ▶ Early clear blebs: good prognostic sign, early hemorrhagic blebs: bad
- ▶ Clear blisters can be debrided but hemorrhagic ones should be left alone
- ▶ Refreezing can cause more damage than waiting for evacuation and definitive treatment (ie if stuck in the environment, don't rewarm and allow to refreeze – wait until you are in a place where you can rewarm and maintain warmth)

In the ER, rapidly rewarm with circulating water at a temperature of 37-39°C

- Trench foot
 - ▶ Immersion injury with prolonged exposure to non-freezing temperatures
 - ▶ Can also cause tissue loss
- Pernio aka chilblain
 - ▶ Repetitive exposure to temperatures just above freezing point
 - ▶ Localized inflammatory lesions; red/purple in color and painful

Let's take a second to discuss dry vs wet gangrene. Gangrene occurs when there is insufficient blood flow to affected tissues. Dry gangrene is the presence of necrotic tissue *without* secondary bacterial infection. Treatment is to apply bulky dressings and prevent development of wet gangrene (gangrene with bacterial infection, treated with emergency surgery and debridement).

- **Heat-related illnesses**
 - ▶ *Prickly heat rash* is a rash that develops after a person sweats more than normal leading to blocked sweat glands; it usually occurs in parts of the body covered by clothing



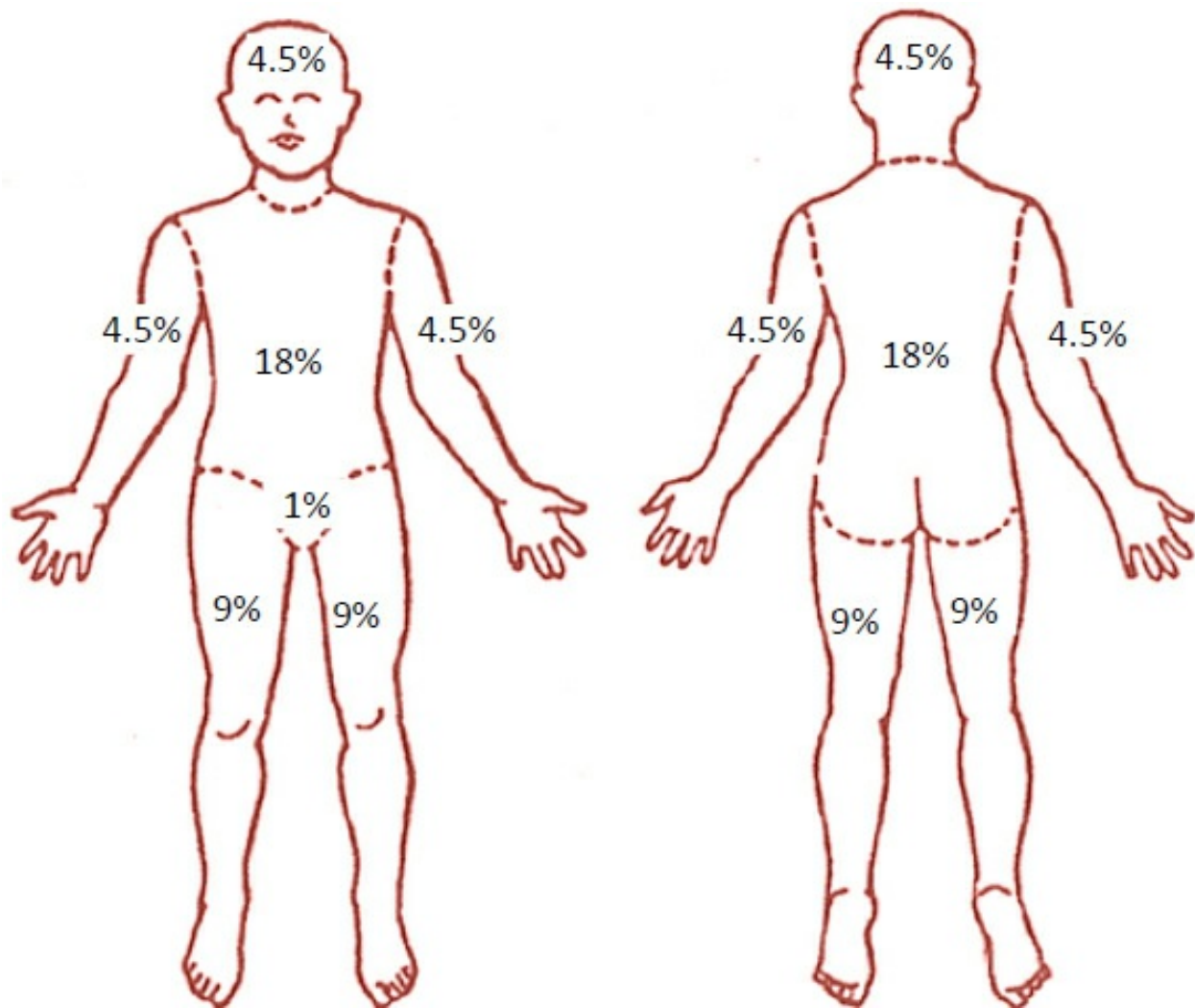
- ▶ *Heat stress* is simply ‘discomfort because it’s hot’
- ▶ *Heat exhaustion* criteria: hyperthermia without CNS dysfunction
 - ◆ If there is CNS dysfunction it is mild and resolves with rest/cooling
- ▶ **Heat stroke**
 - ◆ Two main criteria: hyperthermia (usually >104°F and CNS dysfunction (headache, disorientation, AMS, seizure, or even coma)
 - ◆ Multi-organ failure, shock, and ARDS may also be present
 - ◆ Evidence of tissue destruction (high CK levels, rhabdomyolysis)
 - ☆ *AST is the most sensitive lab finding*

HEAT STROKE

Classic	Exertional
Epidemic	Isolated events
Nonexertional	Exertional
Elderly patients	Healthy active patients
Anhidrosis	Hyperhidrosis
Rarely: rhabdo and ATN	Common: rhabdo and ATN

- ▶ Rapidly lower the core temperature to about 39°C; avoid

- ▶ overshooting and causing rebound hyperthermia
- ▶ Evaporative techniques (spraying water and use of a fan) and ice water immersion are most beneficial
- ▶ Avoid giving antipyretics such as tylenol or ibuprofen
- **Burns**
 - ▶ Classification
 - ◆ 1st degree ('superficial') : Epidermis only, no blisters, sunburns
 - ◆ 2nd degree ('partial thickness') : Dermis + blisters, sensation intact
 - ◆ 3rd degree ('full thickness') : Loss of sensation, white waxy lesion
 - ▶ Rule of 9's to estimate BSA
 - ▶ Rule of palms: 1 palm is equal to 1% BSA (the patient's palm, not yours!)



Lactated Ringers is the fluid of choice – but how much should you give?

- ▶ Parkland formula for IV fluids: $4\text{mL} \times \text{wt (kg)} \times \% \text{BSA}$
 - ◆ Give half in the first 8 hours and the other half in the next 16 hours
 - ◆ Do NOT count superficial (or 1st degree) burns when calculating

For instance if a 70 kg male has 25% partial thickness burns, he will need $4 \times 70 \times 25 = 7000 \text{ mL}$ 3500 mL in the first 8 hours and 3500 mL in the next 16 hours

- ▶ It is *essential* to monitor urine output to determine the efficacy of your fluid resuscitation – hourly urine output should be 0.5mL/kg in

adults

- ▶ Superficial burns should be treated with NSAIDs and topical aloe. For deeper burns, apply topical antibiotic and nonadherent gauze (Adaptic or Xeroform) followed by a second layer of dry gauze and an outer layer of an elastic gauze (Kerlix). For patients being transferred to a burn unit, use dry sterile dressings only.
- ▶ **ATLS guidelines: criteria for referral to a burn unit**
 - ◆ Full thickness burns of any size in any age group
 - ◆ Partial thickness burns > 10%
 - ◆ All burns to face, ears, genitals, hands, feet, major joints
 - ◆ All inhalational injuries (singled nasal hairs, soot in mouth)
 - ◆ Children < 12 months of age
- ▶ Escharotomy
 - ◆ Once eschar formation occurs, the skin loses its ability to expand and becomes restrictive. Any further increase in swelling can be detrimental. If there are circumferential burns of the chest or neck that impair breathing or circumferential burns to extremities that risks compartment syndrome, an escharotomy should be performed.

A man is attempting to rewire his cable when he gets electrocuted. Which of the following will generate the most heat as a result?

- A) Skin
- B) Muscle
- C) Subcutaneous fat
- D) Bone

Answer: D

Explanation: Tissue damage caused by electrical current is all about resistance.

Increased resistance produces increased heat. Tissue resistance: bone > fat > tendon > skin > muscle > blood > nerve. **Bone has the highest resistance** so it generates a lot of heat when exposed to an electrical current leading to destruction of bone matrix and osteonecrosis. Skin has the greatest effect on

severity of injury (wet skin has much less resistance than dry skin). Remember that traumatic injuries are common as patients can fall afterwards and that posterior shoulder dislocations, which are normally quite rare, are associated with seizures and electrical injuries.

- ▶ Fetal mortality is high even with a low current because of low resistance of amniotic fluid (fetal monitoring and ultrasound are indicated for all pregnant women with electrical injury)
- ▶ AC current produces more severe injuries than DC current
 - ◆ AC: exit = entrance, repetitively stimulates muscle contraction
 - ◆ DC: exit > entrance, tends to cause a single muscle spasm that throws the victim and can cause associated traumatic injuries (lightning typically acts as DC current)
 - ◆ AC ~ ventricular fibrillation, DC ~ asystole, Lightning ~ asystole
- ▶ Flash (or arc) burns occur when the current arc strikes the skin, but does not enter the body
- ▶ Lightning strikes are often associated with superficial burns. Lichtenberg figures are unique and pathognomonic. If multiple victims are struck by lightning, triage the opposite of what you would do in a 'multi-casualty' incident. Strike victims who are not in cardiac arrest almost always survive. Those who are apneic or in cardiac arrest should be treated first. Patients struck by lightning can have fixed dilated pupils due to autonomic dysfunction – this should not be a reason to stop resuscitation. The most frequently encountered injury is a ruptured TM.



Always remember **delayed labial artery bleed in children who chew on electrical cords**
(typically occurs on **day 5** as scar falls off)

- Radiation exposure

Earlier onset of symptoms indicates a higher dose and worse prognosis

GI symptoms are most common (nausea/vomiting/diarrhea) and are self-limited; an acute form of gastroenteritis can occur 3 weeks after exposure to radiation

‘Acute Radiation Syndrome’ results from whole-body irradiation over a short time period – stages are prodromal (GI symptoms), latent (symptom-free), manifestation of illness, and either recovery or death

Any contact with skin or clothes requires decontamination - first evacuate the scene to prevent having new victims, determine the exposure type and decontaminate on scene if possible, have a separate hospital entrance with a closed drainage system and ventilation, and wash with soap and water

Tissues with high rates of cell turnover/division are most affected so the hematopoietic system is the most susceptible

48 hour lymphocyte count can be helpful (>1200 good prognosis, <300 bad)

All of the following can be vectors for rabies except:

- A) Fox
- B) Skunk
- C) Chipmunk
- D) Groundhog

Answer: C

Explanation: Rabies can be transmitted by almost any mammal but small rodents are almost never found to carry rabies. It also does not infect birds, reptiles, or amphibians. Remember that rabies can only be spread through broken skin.

Let's sink our teeth into a really fun topic – snake bites!

Common venomous snakes are crotalids (rattlesnake, moccasin, copperhead) and elapids (coral, cobras, mambas etc); crotalids have antivenom available while elapids do not. All cases of potentially venomous snake bites should be discussed with poison control.

Don't put a tourniquet on the bitten extremity

Movement causes muscle contraction and increased absorption of venom – for this reason all patients should be immobilized

What you really need to know about: antivenom. Indications are progression of local injury (pain, swelling), coagulopathy, hypotension, confusion, fasciculations, or paresthesias. 4-6 vials is the recommended initial dose. Observe for at least one hour and if initial control is not achieved, give an additional 4-6 vials. If there is adequate response to the initial dose, give 4 vials every 6 hours for three doses ($\frac{1}{2}$ life of venom $>$ $\frac{1}{2}$ life of antivenom). There are no absolute contraindications to antivenom.

RED TOUCHES YELLOW, KILL A FELLOW



RED TOUCHES BLACK, FRIEND OF JACK



SnakeBuddies

Spider Bites

Brown Recluse Spider bite

Causes a mild erythematous lesion in most cases; can cause a severe reaction with immediate pain, blister, and discoloration: **necrosis and central eschar**

will form over 3-4 days

“Loxoscelism” refers to the systemic reaction that can happen 1-2 days after the bite (fever, chills, vomiting, myalgias, hemolysis – even renal failure and DIC)

The bite may not be witnessed

Treatment is supportive

Black Widow Spider bite

Immediate pinprick sensation so the bite is often witnessed

Symptom onset is fast – within one hour an erythematous target-shaped lesion appears

Myalgias, diaphoresis, vomiting and even respiratory failure can occur

Initial treatment is supportive – analgesics and benzodiazepines for muscle cramps

For severe envenomation, consider hospitalization and antivenin



- Hymenoptera refers to bees, wasps, hornets, yellow-jackets, and ants. Stings typically incite only a local reaction, but anaphylaxis may occur.
- Scorpion Stings
 - ▶ Typically there is no bite mark or sting, which distinguishes it from a spider bite
 - ▶ Venom acts primarily to excite the nervous system
 - ▶ Symptoms are more severe in children compared to adults and may include unusual eye movements, hypersalivation, and muscle jerking

- ▶ *Centruroides* species are potentially life-threatening; sting is followed by immediate pain/paresthesia at the site
- ▶ Antivenin is available but extremely rare, so not routinely recommended

Picture this: you're at the beach



You get out of the water and step on something sharp. You look down and see this:



What should you do next?

- 1 – Blame yourself for not wearing water shoes. It's a sea urchin and they live on the ocean floor!
- 2 – If there are any spikes you can pull out with tweezers, do so
- 3 – Apply vinegar to kill the little parts that *can* poison you
- 4 – Place your foot in as hot of water as you can tolerate for 30 minutes
- 5 – Apply vinegar again
- 6 – If you show signs of infection (redness, fever, or pus): you may need antibiotics

Now imagine you're back at the beach but this time you're swimming around with these guys:



What's the treatment for a jellyfish sting?

- 1 – Remove any tentacles you can see with a tweezer
- 2 – Apply vinegar or acetic acid and then soak it in vinegar for up to 30 minutes
- 3 – Hot water

You may have seen movies where someone is stung by a jellyfish and they have a person urinate on them - so why not? Depending on the pH of the urine (which in turn depends on diet and hydration status), applying urine can actually make the pain worse.

‘Portuguese man-of-war’ is in a family related to jellyfish: they typically sting in a whip-like fashion so they strike on top of the foot for instance rather than the sole.

Treatment is hot water/saltwater (not vinegar).

For stingray or coral, just use hot water

For jellyfish, use vinegar *then* hot water



GASTROINTESTINAL

- **Dysphagia**

Difficulty swallowing is *not* a normal part of aging

- ▶ Taking a good history is critical
 - ◆ Dysphagia to both solids and liquids right from the onset = motility disorder of the esophagus (such as esophageal spasm)
- ▶ Dysphagia for solids that later progresses to involve liquids = mechanical obstruction (such as cancer)

Esophageal stricture is typically a complication of long-standing GERD. Patients will initially be intolerant to solids and progress to being intolerant to liquids.

Achalasia is when the esophagus won't peristaltase and the lower esophageal sphincter won't relax during swallowing. Patients classically stand after eating or raise their arms above their head to try to increase esophageal pressure and aid digestion. Symptoms include dysphagia, weight loss, and heartburn. There is a significantly increased risk of developing cancer. Barium swallow is the best initial test. Because it's a motility disorder, there is intolerance to solids *and* liquids.

Diffuse esophageal spasm (DES) can be provoked by a number of stimuli such as acid reflux, stress, hot or cold food, carbonated beverages, and certain smells – and causes *intermittent* dysphagia.

Zenkers diverticulum is a result of increased pressure in the lower pharynx causing a diverticulum (or pouch) to form. Symptoms include dysphagia, cough, regurgitation, and halitosis from trapped food. It's mainly found in older adults and diagnosis is via barium swallow.

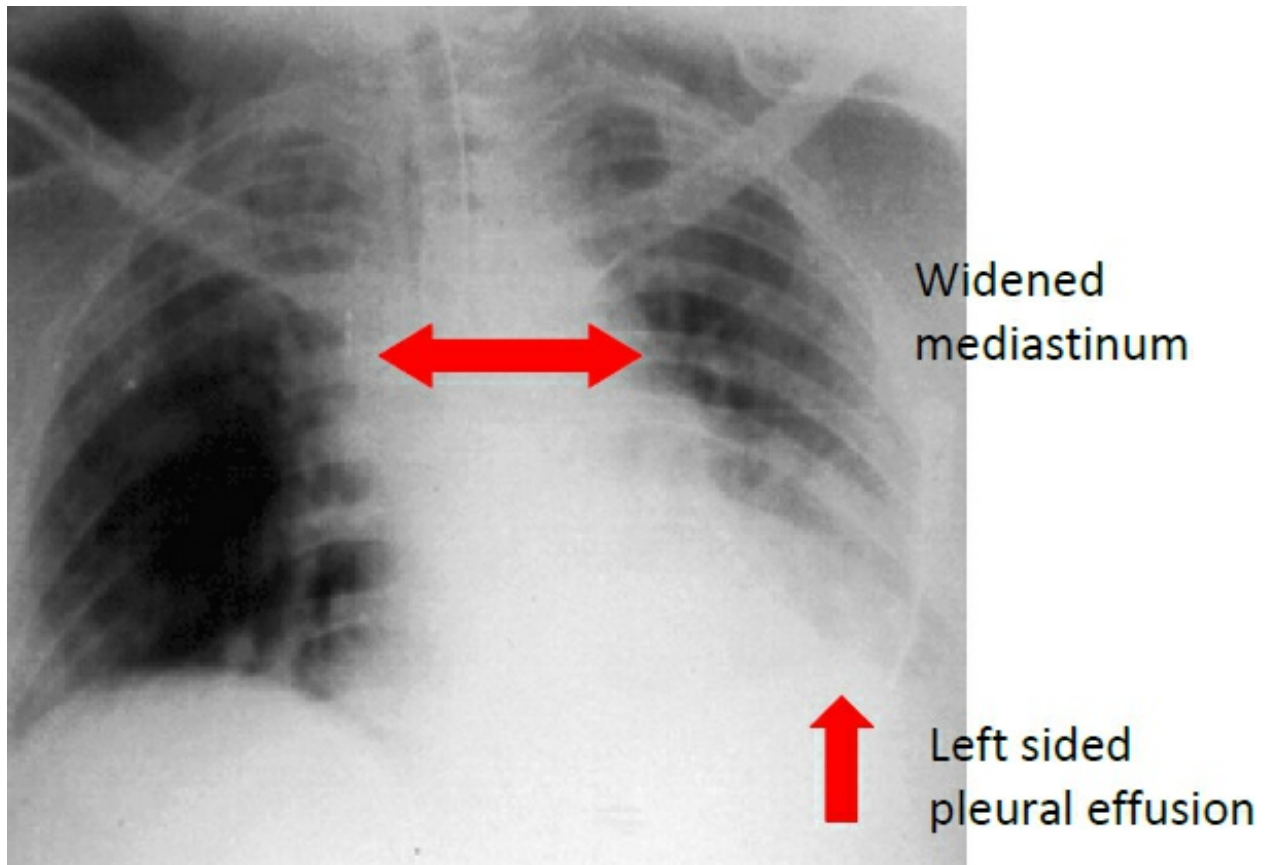


Esophageal web is a congenital membrane that allows liquids but not solids to pass. Patients typically present as infants when solid food is first introduced.

- Esophageal rupture
 - ▶ **Mallory-Weiss tear**
 - ◆ Partial thickness
 - ◆ Location: gastro-esophageal junction
 - ◆ Forceful vomiting leading to bleeding from submucosal arteries
 - ▶ **Boerhaave's Syndrome**
 - ◆ Full thickness
 - ◆ Location: unsupported left posterolateral wall of distal esophagus
 - ☆ Iatrogenic esophageal rupture often occurs in proximal esophagus
 - ◆ Patients typically present with post-emetic chest pain/hypotension
 - ◆ X-ray: pleural effusion, wide mediastinum, and

pneumomediastinum

- ◆ Diagnosis: an upper GI study using water-soluble gastrograffin



- **Esophageal Foreign Bodies:** the most common site of esophageal foreign body entrapment in children is at the cricopharyngeus muscle at C6. In adults it is at the lower esophageal sphincter at T10.
 - ◆ When a radiolucent foreign body is suspected and one is not seen on plain films, CT scan is the next test of choice; avoid oral contrast studies. Bronchoscopy will provide the definitive diagnosis.

A patient presents to the ER with what he thinks is a piece of chicken stuck in his throat. He is initially unable to tolerate secretions, but you give him a dose of glucagon and in the process of getting x-rays the nurse informs you that he thinks it has passed. He is now able to tolerate secretions and looks comfortable. Which of the following is the most appropriate disposition?

- A) Discharge home with liquid diet
- B) Admit for observation
- C) Arrange outpatient endoscopy
- D) Observe in the ER for six hours; if he remains stable, discharge with liquid diet

Answer: C

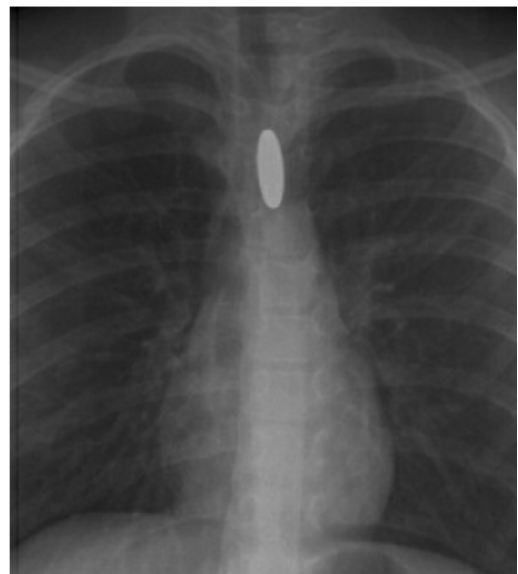
Explanation: Food impaction can be the first sign of an obstructive lesion and endoscopy is indicated in all patients. Glucagon (like nitroglycerin) relaxes the lower esophageal sphincter and is mostly of theoretical benefit.

Coins are the most commonly ingested foreign body in children

Transverse orientation: esophagus



Sagittal orientation: trachea



If the child is symptomatic, it needs to be removed. If the child is asymptomatic AND the coin is in the esophagus (rather than the trachea), they can be observed for up to 24 hours - if it still has not passed then it should be removed. Coins that reach the stomach can be managed expectantly and most will pass within 1-2 weeks; check weekly plain films and if the coin has not passed beyond the stomach after 4 weeks, endoscopy may be necessary.

If it's a button battery in the esophagus, it should be removed immediately. Same for sharp pointed objects - *even if radiographs are negative, perform endoscopy*. The **ileocecal valve is the most common site of perforation**.



Button batteries can look similar to coins but they have a 'halo' or 'double rim' effect

What about magnets? If it's a single magnet it's low-risk (but x-rays can be deceiving as a stack of magnets can look like just one). If there are two or more magnets, they can attract each other across bowel wall leading to perforation and even death.

Any object longer than 5cm and wider than 2cm needs endoscopic removal

Caustic ingestion

- **Alkali ingestions tend to injure the esophagus > stomach**
 - ▶ Liquefactive necrosis leads to rapid (within seconds) progression until stomach acid partially neutralizes/minimizes damage
- Unlike more viscous alkaline solutions, acids can pass quickly into the stomach causing less esophageal damage. Acid ingestions lead to superficial coagulation necrosis that thromboses the underlying blood vessels and forms a protective eschar. It also causes pain upon contact with the oropharynx so the amount of acid ingested tends to be limited.
- Inducing vomiting is not recommended (re-exposes the esophagus to the caustic agent)

- Neutralizing agents (weakly acidic or basic substances) should not be given and damage from them is instantaneous (neutralization releases heat that adds thermal injury to the ongoing chemical destruction)
- Long term complications: esophageal strictures and cancer
- If the patient is asymptomatic and gives a reliable history of a low volume accidental ingestion of low concentration acid or alkali, observation and discharge without endoscopy is the best choice

Peptic Ulcer Disease (PUD)

Gastric	Duodenal
Less common	More common
Biggest risk factor: H. pylori	Biggest risk factor: H. pylori
Pain right after eating, gets worse with food	Pain 2-3 hours after eating, gets better with food
Since pain worsens with food, there is associated weight loss	No associated weight loss
Less likely to bleed	Twice as likely to bleed
Biopsy should be done during endoscopy to rule out malignancy	Does not lead to cancer so biopsy is unnecessary
<ul style="list-style-type: none"> ▶ Treatment: H2 blockers inhibit gastric acid secretion; PPIs block acid secretion by inhibiting the H⁺/K⁺ proton pump and are typically the IV drug of choice in patients with GI bleed; surface protectants (sucralfate) bind to an ulcer and prevent further damage from acid <ul style="list-style-type: none"> ◆ H. pylori: antibiotics ◆ NSAID-induced gastric ulcer: misoprostol ▶ Most common complication of PUD is GI bleed 	

For moderate/severe reflux esophagitis, PPIs are the best initial treatment and strongest suppressor of gastric acid secretion. After healing, H2 blockers are used as maintenance therapy. Maintenance treatment with the prokinetic drug

cisapride has also been shown to prevent the relapse of esophagitis after it has been healed.

Which of the following increases the likelihood of an upper GI bleed?

- A) Passing of clots in the stool
- B) Melena
- C) BUN:creatinine ratio 20:1
- D) Grossly positive rectal exam for blood

Answer: B

Explanation: BUN:creatinine ratios of 30:1 make an upper GI bleed more likely. Grossly positive blood on digital rectal exam can suggest a very brisk upper GI bleed but is more likely to represent a lower source. Remember that medications like pepto-bismol and iron tablets can cause black stools which are hemoccult negative.

Peptic ulcer disease is the most common cause of an upper GI bleed. Other causes include esophageal varices, erosive gastritis, Mallory-Weiss tears, cancer, and Dieulafoy's lesion.

Patients who have cirrhosis and an upper GI bleed should receive PPIs *and* antibiotics as they are immunosuppressed and need prophylaxis. Typical regimen is IV ciprofloxacin or ceftriaxone.

What is Dieulafoy's lesion?

When a large tortuous arteriole in the stomach erodes and bleeds, causing intermittent bleeding. It's difficult to diagnose and even then only by endoscopy.

What if a patient has a AAA repair and ten years later has an upper GI bleed?

He might have an aorto-enteric fistula...

Is there anything that can be done to slow down or stop an upper GI bleed?

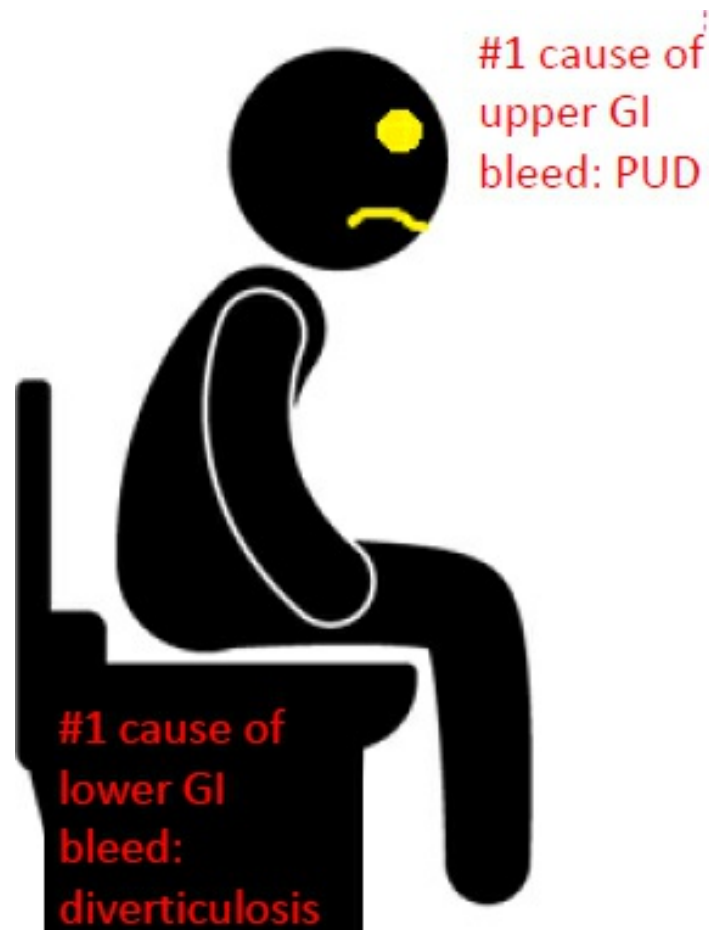
PPIs have more benefit when compared to H2 blockers (lower rate of rebleeding, shorter hospital stays, lower rates of transfusion).

Somatostatin (octreotide) is only beneficial in cases of variceal bleeding

Vasopressin can be used for profuse variceal bleeds when endoscopy will be delayed

One more disease - one that you will probably never see but need to know about:

Osler-Weber-Rendu Syndrome aka Hereditary hemorrhagic telangiectasia
Here's what you need to know: it follows an autosomal dominant inheritance, epistaxis is the most common presentation, and it's associated with telangiectasias of the skin, mucous membranes, and GI tract causing recurrent GI bleeding.



Painless hematochezia in patients < 40 years of age need a digital rectal exam and sigmoidoscopy (not colonoscopy, not CT scan, and not admission)

Hepatitis:

Alcoholic hepatitis typically has an AST : ALT ratio ≥ 2 and even moderate disease can produce increases in INR

Hepatitis A follows fecal-oral transmission (same as Hepatitis E) and is not associated with a chronic carrier state (“Vowels hit your bowels”: Hepatitis A and E are spread by fecal-oral transmission)

Hepatitis B can be transmitted by percutaneous, parenteral, or sexual exposure and has a **small chance of developing chronic hepatitis**. Coinfection of hepatitis B and D is the most common cause of fulminant hepatic failure.

If you only remember one thing from this page, make it these markers:

HBsAg = **hallmark for diagnosis**; appears 1-10 weeks after exposure and is positive even before liver enzymes start to increase

HBsAb = persists for life; sign of previous infection or vaccination and **indicates** immunity

HbcAb IgM = **indicates acute infection**

HBeAg = **indicates high infectivity**

Hepatitis C is acquired through blood transfusions and IV drug abuse and **almost 50% will develop chronic infection**.

Hepatic Encephalopathy:

- AMS, confusion, and coma as a result of liver failure
- Azotemia is the most common precipitant (and GI bleeding can cause azotemia, therefore encephalopathy is often set off by a GI bleed)
- Sleep inversion (sleep during day, awake at night) is an early sign
 - ▶ Treatment: lactulose, decrease dietary protein, and consider empiric antibiotics (rifamixin or neomycin)
- Spontaneous Bacterial Peritonitis (SBP)
 - ▶ Think of this diagnosis in patients with ascites, abdominal pain, and

fever

- ▶ Diagnosis: ascitic fluid with positive culture and > 250 PMNs
- ▶ **Most commonly isolated organism is E.coli**
- ▶ Treatment: cefotaxime, ceftriaxone, or cefepime

Sample question: an alcoholic patient with a known history of cirrhosis presents with abdominal pain. He has ascites and an elevated white blood cell count. Paracentesis reveals > 250 PMNs. Next best step? Start cefotaxime.

Which of the following is the most common cause of abdominal pain in the elderly?

- A) Appendicitis
- B) Cholecystitis
- C) Hepatitis
- D) Pancreatitis
- E) Diverticulitis

Answer: B

- Cholecystitis
 - ▶ Ultrasound findings that suggest cholecystitis: gallstones or sludge, pericholecystic fluid, gallbladder wall thickening $> 3\text{mm}$, common bile duct dilatation $> 6\text{mm}$, enlarged gallbladder
 - ▶ The most sensitive finding on ultrasound is Murphy's sign: the ability to reproduce the patient's pain while applying pressure with the ultrasound probe (great sensitivity and positive predictive value, poor specificity)
 - ▶ If the ultrasound is negative but suspicion remains high, HIDA scan is next
 - ◆ HIDA scan has the highest sensitivity and specificity for cholecystitis
 - ◆ How is it done? IDA is given IV – failure to obtain an outline of the GB within one hour confirms diagnosis; visualization of GB and common duct is a negative study

- Emphysematous cholecystitis is a rare variant; commonly isolated organisms include Clostridium, E. coli, and B. fragilis. Diagnosis is confirmed with ultrasound showing air in the gallbladder wall. It is a true surgical emergency due to the risk of gallbladder gangrene and perforation.

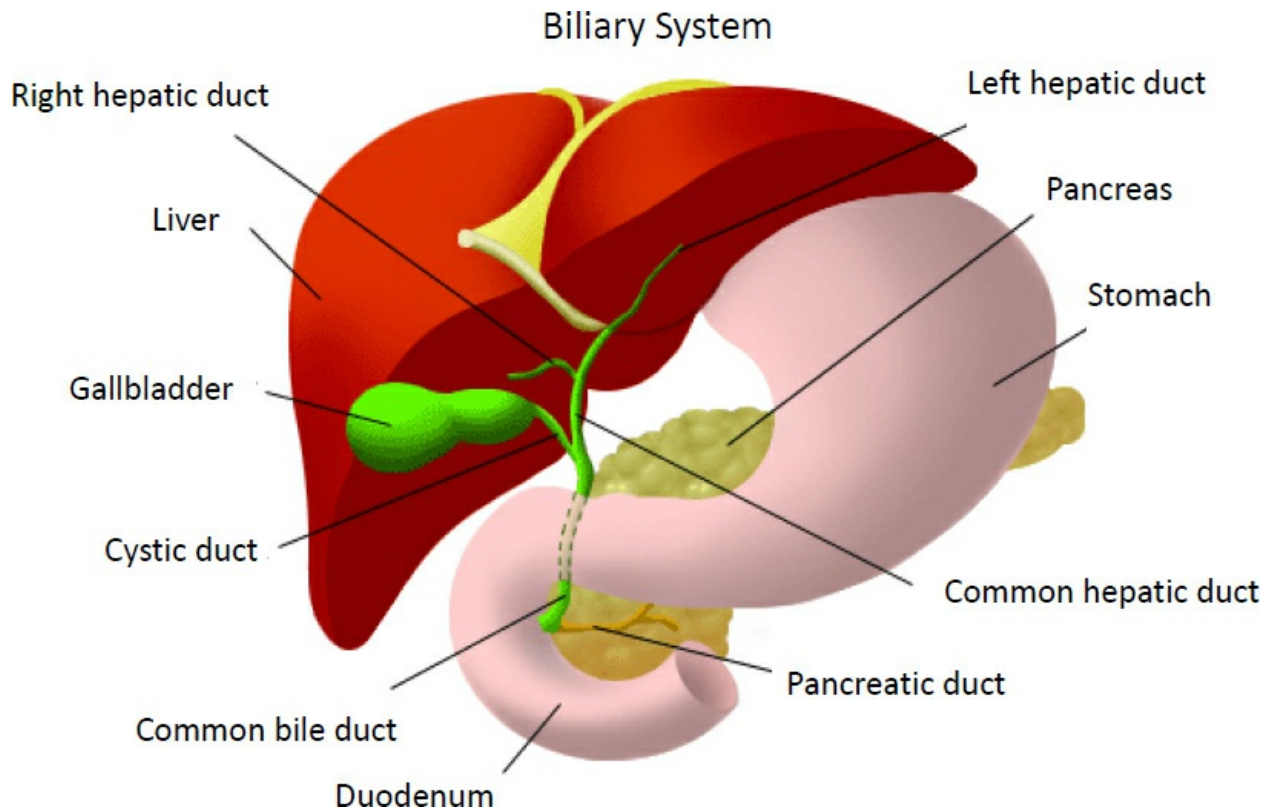
Which of the following is true regarding acalculous cholecystitis?

- A) Patients have a higher mortality rate than those with cholecystitis
- B) Patients have gallstones that cannot be visualized on ultrasound
- C) Patients do not typically have jaundice
- D) It is more common in children as compared to the elderly

Answer: A

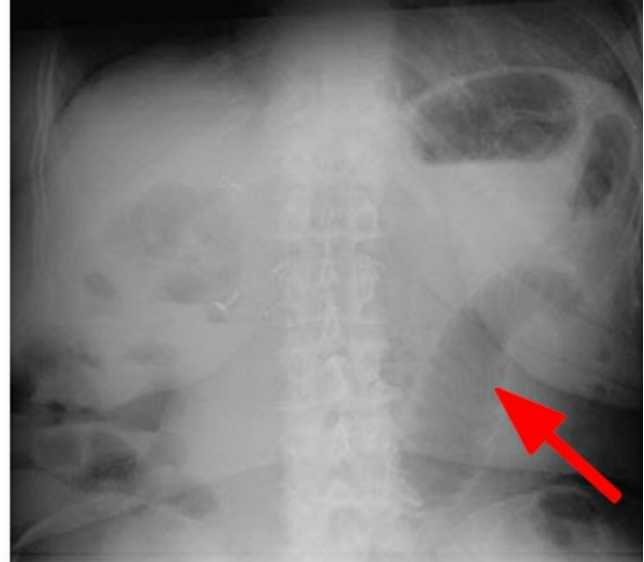
Explanation: Acalculous cholecystitis is clinically similar to cholecystitis. Patients may have jaundice and a palpable RUQ mass. Ultrasound is the diagnostic modality of choice and will show all the same findings as cholecystitis (thickened GB wall, pericholecystic fluid, etc) but no gallstones. It is more common in the elderly and especially in ICU and AIDS patients. There is a much higher mortality rate as compared to cholecystitis.

- Ascending cholangitis
 - ▶ Complete biliary obstruction (from a common bile duct stone or neoplasm) leading to biliary stasis and concomitant bacterial infection
 - ▶ Charcot's triad: RUQ pain, fever, jaundice
 - ▶ This is a surgical emergency! IV antibiotics and surgical consultation



- **Pancreatitis**

- ▶ Numerous causes including gallstones (most common cause of pancreatitis worldwide), EtOH abuse, hypertriglyceridemia, hypercalcemia, medications (thiazides, estrogen, salicylates, propofol, sulfa), trauma, infection (mumps, coxsackie, adenovirus, hepatitis, salmonella), and pregnancy
- ▶ Lipase has higher sensitivity than amylase for diagnosis
- ▶ **ALT has low sensitivity but high specificity for biliary etiology in cases of acute pancreatitis**
- ▶ X-ray or CT can be helpful but routine imaging is not indicated - if pain is atypical or if diagnosis is unclear, CT may be warranted
 - ◆ **Sentinel loop** on x-ray indicates localized ileus from nearby inflammation. In acute pancreatitis, sentinel loop is seen on left side, in acute cholecystitis on the right side, in appendicitis in the right iliac fossa



- ▶ Supportive care (IV fluids, pain meds, NPO) is adequate in most cases
- ▶ Complications of acute pancreatitis: pseudocyst, hyperglycemia, hypocalcemia, volume loss, ARDS, DIC, renal failure, death

Ranson's Criteria: prognostic indicators of inpatient mortality for acute pancreatitis

On admission

Age > 55
WBC > 16
Glucose > 200
AST > 250
LDH > 350

At 48 hours

Calcium < 8
Hematocrit decreased > 10%
PaO₂ < 60
BUN increased > 5
Base deficit > 4
Sequestration of fluids

• **Ileus**

- ▶ Abnormal peristalsis without evidence of mechanical obstruction
- ▶ Symptoms include abdominal pain, constipation, nausea, and distension
- ▶ Ileus is associated with HYPOactive bowel sounds, while small

bowel obstruction has **HYP**ERactive bowel sounds

- ▶ X-ray shows dilated loops of bowel throughout +/- air fluid levels
- ▶ Treatment: bowel rest (NPO), IV fluids, consider NG tube, surgery consult



A post-operative ileus is the most common type, other causes include drugs (opioids, anticholinergics) and electrolyte abnormalities (usually hypokalemia)

- **Gallstone Ileus**
 - ▶ Uncommon cause of small bowel obstruction
 - ▶ Repeated bouts of cholecystitis lead to adhesion of the gallbladder to the small bowel (typically the duodenum) with eventual fistula formation and passage of gallstones into the intestines, causing obstruction
- **Bowel Obstruction**
 - ▶ X-ray shows air fluid levels and dilated fluid-filled loops of bowel

#1 cause of small bowel obstruction: adhesions #1 cause of large bowel obstruction: malignancy



A 70 year old male presents with abdominal pain, obstipation, and nausea. You order plain films and see the following. What's the next best step in management?



- A) Start broad spectrum antibiotics
- B) Place a nasogastric tube

- C) Place both a nasogastric and a rectal tube
- D) Order a CT scan with contrast

Answer: C

Explanation: Most patients with a sigmoid volvulus have slowly progressive pain, nausea, distension, and constipation. Vomiting typically occurs several days after the onset of pain. If left untreated it can lead to bowel necrosis, sepsis, and even death. In patients without evidence of gangrene or perforation, flexible sigmoidoscopy is considered first-line treatment. Following successful detorsion, a rectal tube should be left in place. Immediate laparotomy should be performed in patients with perforation or signs of bowel necrosis. Recurrent volvulus develops in 50% of patients who don't undergo surgery. ER management includes IV fluids, bowel decompression with both an NG and a rectal tube, consultation with GI/surgery, and starting broad spectrum antibiotics.



Sigmoid volvulus is seen in elderly patients with a history of chronic

constipation Cecal volvulus is more common age 25-35 and seen frequently in young/healthy marathon runners or those with history of previous abdominal surgeries. It presents with the same features of a large bowel obstruction and can cause bowel perforation/peritonitis if left untreated. Standard treatment is surgical (laparotomy).

Hernias: lots of terms to learn, unfortunately:

A **reducible hernia** is one in which the herniated structures can be returned through the abdominal wall defect back into the abdominal cavity

An **irreducible hernia** cannot be returned through the defect

Another term for 'irreducible hernia' is '**incarcerated hernia**'

A **strangulated hernia** is when blood supply to herniated structures is compromised

****All strangulated hernias are incarcerated, but not all incarcerated hernias are strangulated****

'**Groin hernia**' refers to inguinal and femoral hernias and are the most common

Umbilical hernias are very common in infants and most of them close spontaneously by the age of two. Rarely do they incarcerate or strangulate.

Femoral hernias are more common in women than in men but are still not the most common type of hernia overall

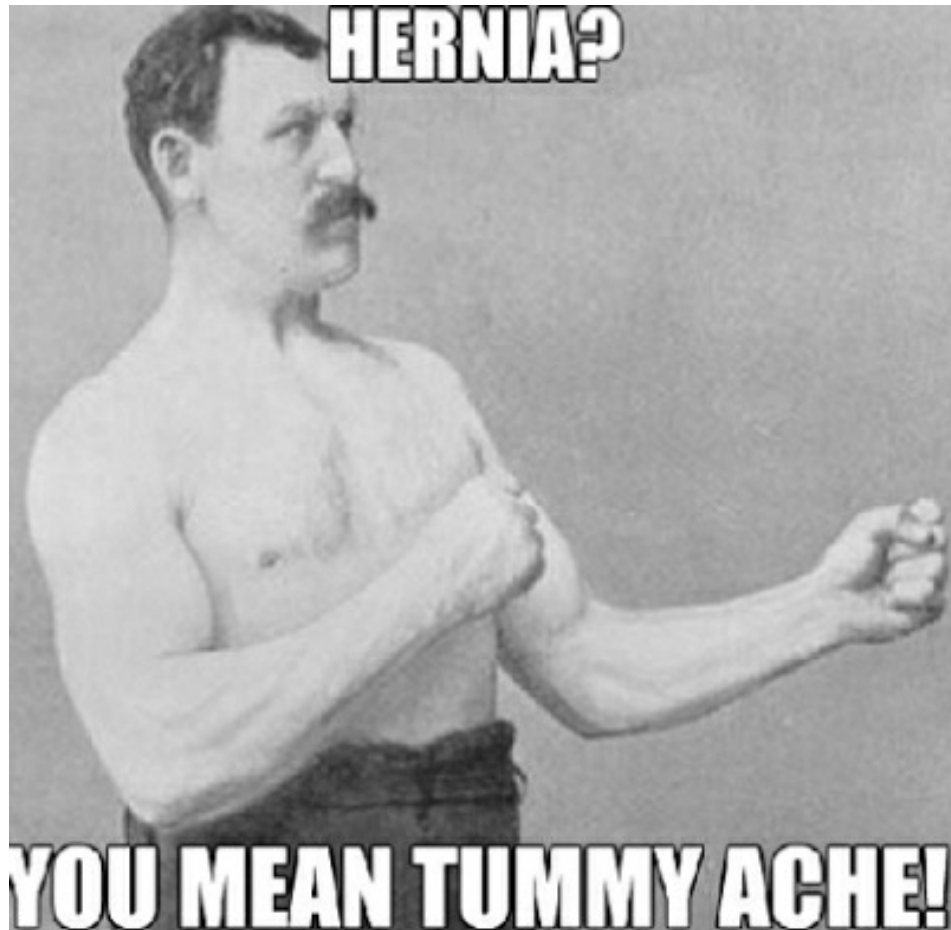
Spigelian hernias are rare but are also very small so at high risk of strangulation

Obturator hernias are almost exclusive to women, especially multiparous ones and those that have recently lost a lot of weight. Presents as pain in the medial thigh (obturator nerve) or it may be seen intraoperatively in cases of bowel obstruction.

Incisional hernias are those that develop at a site where previous incision

was made for some type of surgery

Littres hernia is a rare type caused by incarcerated or strangulated Meckel's diverticulum within the hernia



- Irritable Bowel Syndrome: Diagnosis of exclusion with vague symptoms of abdominal pain, bloating, constipation/diarrhea. It's more common in women and treatment is basically symptomatic control.
- **Inflammatory Bowel Disease**
 - ▶ Chronic inflammatory disease with an exacerbation-remission pattern
 - ▶ Peak incidence ages 15-40
 - ▶ Treatment: sulfasalazine, mesalamine, prednisone

Crohn's	Ulcerative Colitis
Can affect any part of the GI tract – perirectal disease 90% of the time but no rectal involvement	Affects rectum and colon
Skip lesions	Continuous areas of inflammation
Risk of colon cancer increased	Risk of colon cancer significantly increased
Associated with perianal fissures and fistulas	Seldom affects perianal area
Transmural	Submucosal, more superficial
Associated with calcium oxalate crystals	Associated with toxic megacolon

Toxic megacolon is a potentially lethal complication of ulcerative colitis or infectious colitis (C. diff). It develops due to a decrease in tone in the bowel wall; therefore ant motility agents, opioids, and anticholinergic drugs should specifically be avoided. Severe bloody diarrhea is the most common presenting symptom. X-ray will show colonic dilation > 6cm. Treatment consists of supportive care, IV fluids, steroids, and antibiotics – patients may ultimately require colectomy.

Which of the following is most likely to be associated with a fear of eating?

- A) Appendicitis
- B) Chronic mesenteric ischemia
- C) Duodenal ulcer
- D) Bulimia

Answer: B

- **Mesenteric Ischemia**
 - ▶ Highly variable presentation making diagnosis difficult

- ▶ Rapid onset abdominal **pain out of proportion to physical exam findings**
- ▶ Classic patient: minimal tenderness on palpation but severe pain
- ▶ Most patients are elderly; males/females are affected at the same rate
- ▶ Risk factors: afib, CAD, diabetes, HTN
- ▶ Labs are nonspecific; CT angiography is the gold standard for diagnosis
- ▶ Lactic acid levels are elevated in most patients with *bowel infarction* but this is a late finding; a normal lactic acid cannot be used to rule out
- ▶ Early CT findings are nonspecific (small bowel thickening, bowel dilation)
- ▶ A common mistake is to make the diagnosis of 'gastroenteritis' after having normal labs and nonspecific CT findings
- ▶ Four major causes: arterial embolism (most common cause), arterial thrombosis (pain after eating), venous thrombosis (secondary to coagulopathy), and non-occlusive (hypoperfusion to mesenteric vasculature due to low cardiac output)
- ▶ Treatment: aggressive IV fluid resuscitation, broad-spectrum antibiotics, avoid oral intake, heparin, papaverine (to decrease arterial vasospasm); early surgical consultation is essential
- ▶ Chronic mesenteric ischemia is associated with abdominal pain that worsens with food, unintentional weight loss, and a fear of eating

Let's say a patient presents with RLQ abdominal pain, fever, and nausea.

Slam dunk! Appendicitis! Let's go to the OR!

Not necessarily ... There's a disorder known as 'typhlitis' aka 'neutropenic enterocolitis' which can mimic appendicitis. It's classically seen in neutropenic patients (duh); treatment is much more benign (symptom control, possible surgery consultation).

Which of these *most* increases the probability of a patient having appendicitis?

A) Migration of pain from periumbilical area

- B) Nausea and vomiting
- C) Loss of appetite
- D) Right lower quadrant pain
- E) Increased white blood cell count
- F) Low-grade fever

Answer: D

Which of the following statements is true regarding the use of CT scanning in diagnosing appendicitis?

- A) A negative CT scan does not rule out appendicitis
- B) CT is 100% sensitive for appendicitis but not 100% specific
- C) CT is 100% specific for appendicitis but not 100% sensitive
- D) CT imaging is required to confirm all cases of acute appendicitis
- E) Ultrasound is superior to CT scans in diagnosing appendicitis

Answer: A

Explanation: CT imaging has not replaced clinical judgment and an equivocal or even negative scan does not rule out appendicitis. If clinical suspicion remains high, admission for serial abdominal examinations and surgery consultation is appropriate. Plain films may show appendicoliths and ultrasound can demonstrate a dilated appendix ($> 6\text{mm}$) but neither have been shown to be superior to CT. In pediatric patients ultrasound is often preferred as a first-line imaging test due to potential exposure to radiation in children.

- **Appendicitis**

Right lower quadrant pain is the most sensitive finding

- ▶ WBC count may be normal or raised
- ▶ Increased frequency of perforation in children and the elderly
- ▶ The most frequent diagnosis in missed cases is 'gastroenteritis'
- ▶ Retrocecal appendix: appendix is located behind the cecum; deep RLQ palpation will fail to demonstrate pain - similarly, if the appendix lies entirely within the pelvis, there is usually complete absence of abdominal rigidity (in such cases a DRE can elicit

tenderness in the rectovesical pouch)

Rovsing's sign : LLQ palpation causes RLQ pain

Psoas sign : RLQ pain on thigh extension while lying in left lat decub position

Obturator sign : RLQ pain with internal rotation of flexed right thigh

- **Diverticulitis**

- ▶ Typical presentation: crampy LLQ abdominal pain, nausea, bloating, diarrhea *or* constipation – very similar to irritable bowel syndrome
- ▶ Painless rectal bleeding
- ▶ CT scan is the preferred test for diagnosis, but not all patients need one
- ▶ Treatment: broad spectrum antibiotics with coverage for E.coli and B. fragilis; typical regimen is metronidazole + ciprofloxacin
- ▶ If managed as an outpatient, patients should be put on a clear liquid diet for 2-3 days and advanced as tolerated. When more stable, a high fiber diet should be started
- ▶ **The most common complication is abscess formation**
- ▶ The American Gastroenterological Association updated its guidelines on management of acute diverticulitis in 2015. They now recommend using antibiotics selectively, rather than routinely, in patients with acute uncomplicated diverticulitis. They also recommend against routinely advising patients to avoid popcorn and nuts.

Compare this to diverticulOSIS: the most common cause of lower GI bleeding.

Diverticulosis is self-limited and managed with high-fiber diet and stool softeners.

Diarrhea

Most cases of diarrhea are viral and do not yield white blood cells in the stool.

Invasive diarrhea, on the other hand, is associated with fecal WBCs and blood in the stool. This basically means the infection has evolved into dysentery and has invaded the intestinal mucosa. Causes of invasive diarrhea include:

- ▶ **E. coli 0157:H7**
 - ◆ Incubation period (time from exposure to symptom onset) is 3-4 days
 - ◆ Hemolytic-uremic syndrome (HUS) is the major systemic complication and begins 5-10 days later: anemia, renal failure, thrombocytopenia
 - ◆ Enterohemorrhagic E. coli is associated with undercooked hamburger meat, petting zoos, raw milk, or untreated water
 - ◆ Antibiotics can actually worsen symptoms by promoting toxin release
 - ◆ Not typically associated with systemic signs (eg fever) because the organism is technically not invasive, but produces toxins which are
- ▶ **Salmonella**
 - ◆ Causes **loose watery stools** but may test positive for blood
 - ◆ Associated with pet turtles, eggs, and food poisoning
 - ◆ Treatment: IV fluids and electrolyte replacement; antibiotics have no benefit in healthy immunocompetent patients. Those with severe diarrhea, high fever, or who need hospitalization can benefit from 3-7 days of antibiotics (cipro, bactrim, or amoxicillin)
- ▶ **Shigella**
 - ◆ Classic symptoms: abdominal pain, fever, **bloody diarrhea**
 - ◆ Very efficient pathogen: small inoculum can cause infection
 - ◆ Antimotility drugs (loperamide) should be avoided
 - ◆ Treatment: antibiotics for suspected cases in sick individuals or any culture-confirmed case (IV ceftriaxone or oral azithromycin)
- ▶ **Campylobacter**

- ◆ Cramping, periumbilical abdominal pain, bloody diarrhea
- ◆ Fecal-oral transmission through contaminated food and water
- ◆ Associated with *Guillain-Barre* and *pseudoappendicitis*
- ▶ **E. histolytica**
- ▶ Symptoms range from mild diarrhea to severe dysentery producing abdominal pain, diarrhea and bloody stools. Fulminant colitis with bowel necrosis (leading to sepsis and death) can occur.
- ▶ Associated with liver abscess and [fatal] cerebral amebiasis
- ▶ **All should be treated, even asymptomatic cases**, given the potential to develop invasive disease and the risk of spread to family members
- ▶ Treatment: metronidazole alone for asymptomatic cases, add paromomycin for invasive cases
- ▶ **Yersinia enterocolitica**
 - ◆ Can cause fever and RLQ abdominal pain, hence: ‘Pseudoappendicitis’
 - ◆ Post-infectious sequelae include erythema nodosum and reactive arthritis
 - ◆ Most cases don’t require antibiotics

A 40 year old well-appearing male presents to the ER with six days of crampy abdominal pain and non-bloody diarrhea. What is the best approach?

- A) IV fluids and discharge home with antibiotics
- B) Lab tests, IV fluids, and discharge home with antibiotics
- C) Oral rehydration and discharge home with antibiotics
- D) Send stool cultures and discharge home pending the results
- E) Oral rehydration and discharge home with symptomatic care

Answer: E

Traveler’s diarrhea is a topic that always seems to come up. Here’s what you need to know: most cases are due to enterotoxigenic *E. coli* (ETEC) and a single dose of oral **ciprofloxacin** should be given. In children, pregnant women, and those who just returned from SE Asia (where *Campylobacter* is

more common than ETEC), a single dose of **azithromycin** will suffice. In patients with bloody stools or fever, send a culture and extend antibiotics to three days. Antimotility agents can provide symptomatic relief but should be used in combination with antibiotics.

- *Vibrio vulnificus* is associated with raw oysters and seafood, can have some *characteristic skin findings*, and is generally more aggressive
- *Vibrio parahaemolyticus* is associated with raw oysters and seafood but is self-limited and *does not have skin findings*
- **Cholera**
 - ▶ “Rice water” diarrhea leading to large volume losses
 - ▶ Spread by contaminated food and water and associated with shellfish
 - ▶ Treatment is centered around IV fluids. If patients have large volume losses or if there is an epidemic, antibiotics may be used.
 - ▶ **Antibiotics are generally not recommended for watery diarrhea, as most cases resolve spontaneously - one exception is for treatment of severe cholera in outbreak settings**
- **Giardia**
 - ▶ Water is a major source of transmission – cysts survive in mountain streams so water-dwelling mammals (such as beavers) can become infected and may serve as ongoing sources of water contamination
 - ▶ Transmitted by fecal-oral route and through anal sex
 - ▶ Symptoms include watery diarrhea (typically lasting > 2 weeks), foul smelling fatty stool (steatorrhea), bloating, nausea, etc.
 - ▶ Diagnosis: **stool antigen is the test of choice** – not stool for ova and parasites. The CDC recommends three separate stool ova/parasite tests be done to capture a positive result. Stool antigen, on the other hand, is consistently present regardless of whether there is active shedding.
 - ▶ Treatment: metronidazole; close contacts should be treated as well
- **Cryptosporidium**
 - ◆ Can cause anything ranging from an asymptomatic infection to

a mild diarrheal illness to a severe enteritis with or without biliary tract involvement

- ◆ Most common cause of chronic diarrhea in AIDS patients
- ◆ Usually resolves without therapy in 10-14 days in immunocompetent patients
- ◆ For HIV patients, HAART therapy should be started right away; once the CD4 count is above 100, symptoms may completely resolve

Food poisoning

- Staph aureus
 - ▶ Most common cause of food borne disease
 - ▶ Associated with potato salad, meat, poultry, eggs, and cream-filled pastries
 - ▶ Symptoms begin within six hours of ingestion
 - ▶ Antibiotics are not required; symptomatic treatment
- C. perfringens
 - ▶ Associated with undercooked meat and poultry or with food that was prepared correctly but left out for too long (buffets)
 - ▶ Symptoms: abdominal cramps, watery diarrhea
 - ▶ Fecal WBCs and RBCs are negative
 - ▶ Usually resolves within 24 hours so antibiotics are not recommended
- B. cereus
 - ▶ Associated with fried rice
 - ▶ Two forms: vomiting (2-3 hours post ingestion, resembles S. aureus) and diarrheal (6-14 hours after ingestion, resembles C. perfringens)
 - ▶ Self-limited so antibiotics are generally not needed
- Botulism
 - ▶ Heat-labile neurotoxin
 - ▶ Canned foods and honey are frequent culprits

- ▶ Symptoms include descending paralysis, anticholinergic findings, ‘floppy baby’ syndrome, diplopia (**most common early finding in adults**), ptosis, dysarthria
- ▶ Treatment: antitoxin
- **Scromboid** poisoning
 - ▶ Associated with tuna and mahi mahi
 - ▶ **Histamine-like toxin** with rapid symptom onset (within 30 minutes) of facial flushing, diarrhea, abdominal cramps, and palpitations
 - ▶ Treatment is antihistamines and H2 blockers
- **Ciguatera**
 - ▶ Associated with barracuda and red snapper fish
 - ▶ GI symptoms (nausea, vomiting, diarrhea) followed by neuro symptoms (headaches, numbness, **paresthesias, ataxia, hot-cold reversal**)
 - ◆ Sometimes misdiagnosed as multiple sclerosis
 - ▶ Treatment is antihistamines
 - ▶ Symptoms can last for years: patients should continue to avoid these fish
- Pseudomembranous Enterocolitis
 - ▶ Due to overgrowth of toxin-producing *C. difficile*
 - ▶ The most effective method of prevention is proper antimicrobial prescribing. Common precipitating antibiotics include clindamycin, cephalosporins, and amoxicillin
 - ▶ Hand washing and PPE are also important for prevention
 - ▶ Symptoms include diarrhea (mostly non-bloody), abdominal pain, fever, and maybe even rebound tenderness (ie patients look sick)
 - ▶ Diagnosis: immunoassay for toxin in stool
 - ▶ Treatment: stop antibiotics, treat with oral metronidazole or vancomycin

How do you decide between metronidazole or vancomycin?

For *non-severe* infection, metronidazole is first-line. For first time recurrence, re-treat with metronidazole; second time recurrence use oral vancomycin. For *severe* infection, vancomycin is first-line. In critically ill patients with

fulminant or refractory disease, oral vancomycin + IV metronidazole is recommended.

- Rectal Prolapse
 - ▶ Full thickness protrusion of rectum through anal canal; sensation of rectal mass
 - ▶ Can be a sign of cystic fibrosis in children
 - ▶ Treatment: adults require surgery, children can be managed expectantly and *may* require surgery
- Rectal Intussusception aka internal rectal prolapse
 - ▶ Rectum telescopes down within the rectum or down into the anal canal
 - ▶ More common in women from damage to the pelvic floor during childbirth
 - ▶ Symptoms include sensation of needing to empty bowels and feeling of inability to completely empty them
 - ▶ Treatment: pelvic floor training, dietary changes, surgery

A 60 year old male presents with a chief complaint of having painful bloody bowel movements. Which of the following findings on physical exam would most warrant further workup?

- A) Evidence of a thrombosed external hemorrhoid
- B) Evidence of internal hemorrhoids
- C) Presence of a perianal abscess
- D) Presence of an anal fissure located in the left lateral position

Answer: D

Explanation: Anal fissures are typically located in the posterior anal midline. Non-midline fissures suggest more serious conditions such as cancer, HIV, or Crohns.

- **Anal Fissure**
 - ▶ **Most common cause of painful rectal bleeding**

- ◆ Internal hemorrhoids are the #1 cause of painless rectal bleeding
- ◆ Diverticulosis is the most common cause of lower GI bleed
- ▶ Most common cause of an anal fissure is a superficial tear in the anoderm (typically in constipated patients who pass a hard stool)
- ▶ Treatment: WASH regimen (warm water [sitz baths], analgesia, stool softeners, high fiber diet). Topical nitrates may also be beneficial.
- **Hemorrhoids**
 - ▶ Bleeding (BRBPR), anal pruritus, prolapse, and pain due to thrombosis External: below the dentate line; painful thrombosis
 - ▶ Internal: above the dentate line; painless rectal bleeding
 - ▶ Risk factors: constipation, pregnancy
 - ▶ Treatment: sitz baths, analgesics, stool softeners, high fiber diet, topical steroids, surgery
 - ▶ Thrombosed hemorrhoids should be incised (via elliptical incision)
- **Perianal abscesses** are superficial infections that cause no fluctuance or pain on rectal exam. **Patients can safely undergo incision/drainage in the ER.**
- Ischiorectal abscesses are larger, more indurated, and may not manifest external skin findings. **Ischiorectal and perirectal abscesses should be drained in the OR.**
- **In general, abscesses above the dentate line should be drained in the OR**
- Pilonidal cysts are painful fluctuant areas in the presacral region. Cysts result from hair follicles/glandular secretions that become indurated. They are more common in hirsute men, those with poor hygiene, and those who have repetitive microtrauma. They are *always* located in the midline. The most common complication is recurrence: refer to a surgeon for excision.

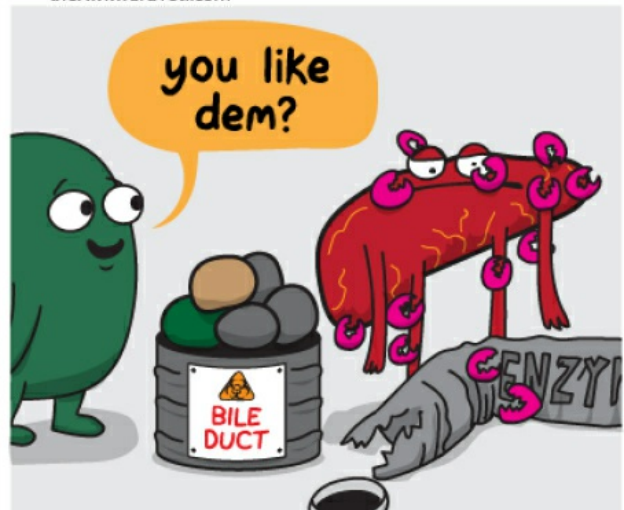
Pancreatitis



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HEMATOLOGY

Nurse: “Doctor, I think this patient’s having a really hard time breathing...”

ER intern: “What’s his O₂ sat? Is he cyanotic?”

Nurse: “95%. Well, no...”

ER Intern: “Then he can’t be having *that* hard of a time, right?”

Oxygenation is difficult to assess with physical exam alone – frank cyanosis doesn’t develop until the SaO₂ reaches around 67%.

Pulse oximetry is a noninvasive measurement of arterial hemoglobin saturation and does not measure PaO₂ so relying on it might delay detection of clinically significant hypoxemia. Patients with carbon monoxide poisoning or chronic heavy smokers might have a falsely raised O₂ saturation and readings can also be affected by profoundly low hemoglobin levels (< 5).

Carboxyhemoglobinemia

Carbon monoxide is an odorless, colorless, tasteless gas that is one of the leading causes of poisoning death. Intentional poisoning is one thing, but unintended poisoning should be suspected in cases of fires with smoke inhalation or in patients who live in homes with poorly functioning heating systems. Presentations are vague and nonspecific - headache is the most common presenting symptom.

Carbon monoxide binds to hemoglobin with higher affinity than oxygen, so the first step in management is high-flow oxygen.

Patients who smoke can have CO levels up to 10% at baseline; nonsmokers can have up to 3%

Clinical signs on exam are usually confined to changes in mental status. “Cherry red lips” are a good buzzword to know but are not a very sensitive finding. Severe CO poisoning can cause myocardial ischemia, ventricular

arrhythmias, pulmonary edema, seizures, syncope, or even coma.

Knowing that high-flow oxygen is the best first-line treatment, hyperbaric oxygen can be used in severe cases. Indications for hyperbaric oxygen for CO poisoning:

- ▶ Loss of consciousness, coma, or seizures
- ▶ CO levels > 25% regardless of symptoms (>15% in pregnant women)
- ▶ Myocardial ischemia or life-threatening dysrhythmia
- ▶ Evidence of end-organ damage regardless of CO level
- ▶ Persistent symptoms after treatment with high-flow oxygen

Hyperbaric oxygen has not been shown to reduce mortality or the risk of MI or dysrhythmia

Diagnosis of CO poisoning means you have to do more than just a standard ABG : get co-oximetry (to measure CO levels)

Can I get a venous sample? Sure! It might be a little less accurate but it's great for screening large populations or to monitor response to treatment. For instance, let's say a family of five comes in because it's winter and they were minding their own business when these two dudes stole all their heat. Now they've got headaches!

:(

Rather than do an arterial blood draw on all of them, just check venous samples!

:)

And finally, don't forget about cyanide! CO and cyanide are clinically indistinguishable. Sure, you can try smelling for bitter almonds (cyanide) but who even knows what bitter almonds smell like?! Obviously if a patient has a high CO level they have CO poisoning. What about **cyanide**? Look for a **severe refractory metabolic acidosis** and a large anion gap. There is no 'cyanide level' to check.

Methemoglobinemia

What is it? A state of altered hemoglobin in which the ferrous (Fe^{2+}) irons of heme are oxidized to the ferric (Fe^{3+}) state, and as everyone knows, ferric hemes are UNABLE to bind oxygen

What does it mean for patients? Patients will have a greater 'functional anemia' than what the lab tests show – even if the hemoglobin levels are normal they're not working correctly, leading to impaired oxygen delivery to tissues

How will patients look? Will they be sad about having methemoglobinemia? Exactly! They'll be blue – cyanotic, that is. And they may have chocolate brown blood.

Acute onset cyanosis should always raise suspicion for methemoglobinemia. For instance, the patient who becomes cyanotic during an endoscopy immediately after receiving a spray of benzocaine.

Causes? **Drugs, drugs, drugs**

- ▶ Lidocaine, dapson, benzocaine spray, sulfonamides, pyridium, inhaled nitrous oxide, aniline dyes, nitrate additives (sausage)
- ▶ This is one reason pyridium is only prescribed for two days for UTI pain

Treatment is to stop the offending agent and give methylene blue. But be careful about using methylene blue in patients with G6PD deficiency! Ideally screen all populations at risk (African American, Mediterranean descent, SE Asians) before giving. The dose is 1-2mg/kg by slow IV push.

Anemia

MCV stands for the 'mean corpuscular volume' and refers to the size of the RBC. If the MCV is high (>100) think B12 or folate deficiency. If it's low, think 'TIPS':

- ▶ Thalessemia
- ▶ Iron deficiency anemia
- ▶ Pb (lead) poisoning
- ▶ Sideroblastic

RDW stands for 'red cell distribution width' and refers to the size variability of RBCs.

Reticulocyte count is reflective of RBC production. It's most often measured in patients with sickle cell disease. Contrary to popular belief, a retic count has no correlation with the presence of an acute pain crisis. It's most useful to evaluate for aplastic crisis.

Coombs test is used to detect antibodies directed against one's RBCs; it's most useful in diagnosing autoimmune hemolytic anemia.

When patients are transfused, one unit of pRBC is expected to raise the hemoglobin by 1-1.5

- Type O negative = universal donor
- Type AB positive = universal recipient

Most trauma centers have a **massive blood transfusion** protocol that's sometimes needed in major traumas when > 10 units of pRBC are given within the first 24 hours of admission.

Why all the protocols? The guy needs blood so load him up!

Well, he's also going to need platelets and clotting factors if he's getting that much pRBC. He can also get hypothermia, ARDS, and hypocalcemia.

FFP:platelet:pRBC ratio should approach 1:1:1

A patient is receiving a blood transfusion when he becomes acutely short of breath and hypoxic. The transfusion is stopped and a chest x-ray reveals diffuse bilateral infiltrates. What should be done next?
Diuretics? Nitrates? Aspirin? Antibiotics?

The patient is suffering from what is known as TRALI – transfusion associated acute lung injury. It's a type of non-cardiogenic pulmonary edema that characteristically does not respond to diuresis. Treatment is to stop the transfusion, disconnect tubing, and administer supplemental oxygen/ventilatory support.

Transfusion Reactions:

1) Acute hemolytic

Most often due to lab error or incorrect type/crossmatch

Patients can develop fever, chills, chest pain, hypotension

Stop transfusion immediately and send blood to test for hemolysis

2) Febrile non-hemolytic

Most common transfusion reaction and develops when the recipient has antibodies to the donor WBCs

Produces a short-lived fever which can be treated with antipyretics

3) Allergic reaction – urticaria, pruritis, anaphylactic shock

4) Transfusion associated acute lung injury (TRALI) - respiratory distress and noncardiogenic pulmonary edema that usually resolves within 96 hours

Autotransfusion

- Sometimes used in trauma patients and in those undergoing cardiac/orthopedic procedures to reduce risk of infection/massive transfusion – also used for those with rare blood types
- **Major indication: hypotension associated with hemothorax**
- Contraindications: bacterial infection, malignancy, renal or hepatic insufficiency, coagulopathies, blood collecting in the autotransfuser for > 6 hrs
- Remember that the patient will also need FFP + platelets

Which of the following patients needs a platelet transfusion?

- A) Non-bleeding patient with platelet count of 15,000
- B) Non-bleeding patient on warfarin with platelet count of 45,000
- C) Patient who will be getting a paracentesis with platelet count of 60,000
- D) Non-bleeding patient with a chronic subdural and platelet count of 110,000

Answer: B

Explanation: Indications for platelet transfusion are:

- Anyone with a platelet count < 10k
 - Anticoagulated patients with no bleeding < 50k
 - Surgery with active bleeding < 50k
 - Major surgery or invasive procedure (such as an LP or thora/paracentesis) with no active bleeding < 50k
 - Ocular or neurosurgery and no bleeding < 100k
- Coagulation Labs – PT/INR and aPTT – what do you actually need to know?
 - ▶ They are over-ordered. Numerous studies have demonstrated that they don't need to be a part of every 'chest pain' order set, yet they are
 - ▶ PTT is good for monitoring heparin use – beyond that it should be ordered only in cases of excessive bleeding or suspected coagulopathy
 - ▶ What if a patient has a normal PT with a prolonged aPTT? If heparin isn't being used, consider lupus anticoagulant or a factor deficiency. The next step is to order mixing studies.

Which of the following tests is most useful in determining need for transfusion following a motor vehicle accident in which the patient has normal vital signs and a negative FAST scan?

- A) PT
- B) aPTT
- C) INR
- D) CBC
- E) Thromboelastogram

Answer: E

Explanation: Thromboelastography measures the the properties of whole blood clot formation under stress, including the interaction of platelets with the coagulation cascade. It does not necessarily correlate with the PT, aPTT, or INR, and is considered a more accurate representation of a patient's need for transfusion following trauma.

Which of the following lab findings would not be expected in someone with disseminated intravascular coagulation (DIC)?

- A) Increased fibrinogen levels
- B) Prolonged PT
- C) Increased fragmented RBCs
- D) Thrombocytopenia
- E) Increased d-dimer

Answer: A

Explanation: DIC, also known as ‘consumptive coagulopathy’, produces both thrombosis and hemorrhage. An excessive production of thrombin and widespread deposition of fibrin results in tissue ischemia and consumption of platelets, fibrinogen, and prothrombin, which in turn may lead to bleeding. Expected findings include prolonged PT/aPTT, thrombocytopenia, increased fragmented RBCs, elevated FDPs, and a low fibrinogen level. Treatment is aimed at the underlying cause; platelets and clotting factors may be needed. If administering clotting factors doesn’t stop the bleeding, heparin may be needed. It works by potentiating antithrombin III to inactivate thrombin and stop consumption of clotting factors.

- **Hemolytic-Uremic Syndrome (HUS)**
 - ▶ Most cases begin with bloody diarrhea from either a foodborne illness (classically E.coli 0157:H7) or from a contaminated water supply. 5-10 days after the diarrhea begins patients may develop HUS. The classic triad is hemolytic anemia, thrombocytopenia, and acute kidney injury. HUS predominately affects children but can, in rare cases, be found in adults. Management is mostly supportive care.
- **Thrombotic Thrombocytopenic Purpura (TTP)** – the mnemonic is FAT-RN and all five findings do not need to be present at the same time
 - ▶ Fever
 - ▶ Anemia (microangiopathic hemolytic anemia)
 - ▶ Thrombocytopenia

- ▶ Renal failure
- ▶ Neurologic deficits (typically transient)

Patients with primarily renal symptoms classically have HUS; those with primarily neurologic symptoms have TTP and those with both neuro and renal symptoms are diagnosed with TTP-HUS

- ▶ First-line treatment of TTP is plasmapheresis. Avoid transfusing platelets as it can lead to worsening thrombosis, renal failure, and death.
- ▶ TTP-HUS is considered a medical emergency and treatment with plasmapheresis should begin daily until platelet levels return to normal.
- **Immune Thrombocytopenic Purpura (ITP)**
 - ▶ *Isolated thrombocytopenia* (remainder of CBC is normal)
 - ▶ Symptoms/signs: petechiae, purpura, bruising, epistaxis – overt GI bleeds are uncommon
 - ▶ Almost no risk of intracranial hemorrhage
 - ▶ Chronic disease that affects women > men
 - ▶ **Prednisone** is first-line treatment but not all patients require it
 - ◆ Platelets < 30,000 need treatment
 - ◆ Platelets 30-50,000 with active bleeding need treatment
 - ▶ Splenectomy if patient is refractory to treatment or has recurrent episodes

To summarize, HUS is self-limited. TTP and TTP-HUS are treated with plasmapheresis. ITP is treated with steroids, IVIG, and splenectomy in extreme cases

- Low Molecular Weight Heparin (LMWH) **does not cross the placenta**. No monitoring necessary as it does not affect the aPTT.
 - ▶ Reversal agent: protamine sulfate (1mg reverses 1mg of lovenox)
- Heparin inhibits clotting factor activity and monitoring of aPTT is required. It does **not cross the placenta** so it's safe to use in pregnancy (unlike warfarin)

- ▶ Reversal agent: protamine sulfate (1mg reverses 100units of heparin)
- ▶ Protamine can cause histamine release and hypotension so infuse slowly
- **Heparin-induced Thrombocytopenia (HIT)**
 - ◆ Usually occurs within the first ten days of treatment with heparin but can occur much later
 - ◆ Associated with a fall in the platelet count of >50%
 - ◆ Earlier onset of HIT may be seen if the patient received heparin in the previous 1-3 months and still has circulating HIT antibodies
 - ◆ Platelets don't typically fall < 20,000 so *spontaneous bleeding is unusual* (unlike ITP for instance where platelets fall extremely low and bleeding is expected)
 - ◆ *Skin necrosis at the site of heparin injections should raise suspicion*
 - ◆ LMW heparin (lovenox) can also cause HIT but at a much lower rate
 - ◆ Prevention: Avoid using heparin for more than five days if possible and use LMWH whenever possible
 - ◆ Treatment: Stop heparin and start an alternative such as a direct thrombin inhibitor (bivalirudin)
 - ☆ Platelet transfusion can actually precipitate thrombosis so use with extreme caution
 - ☆ Warfarin can be started when platelets > 150,000
 - ◆ *Patients with HIT can receive heparin in the future but only if necessary* (short dose before CABG for instance)

Now let's take the case of a patient needing a paracentesis with a platelet count of 60,000. His INR is 6. Which of the following is the most appropriate next step?

- A) Oral vitamin K, wait four hours, perform the paracentesis
- B) 2 units FFP and oral vitamin K, wait four hours, perform the paracentesis
- C) 2 units FFP and SQ vitamin K, wait two hours, perform the paracentesis

D) Perform the paracentesis with no additional treatment

Answer: D

Explanation: Coagulation tests have not been shown to affect morbidity or mortality in patients receiving paracentesis. As long as the platelet count is > 50k, the procedure can be done.

- Warfarin inhibits synthesis of clotting factors II, VII, IX, and X in the liver and requires monitoring of PT (INR)
 - ▶ You might be given the scenario of a patient on warfarin who has an intracranial hemorrhage. FFP is one option for reversal, but it has a delayed onset of action. PCC (prothrombin complex concentrate), also known as Kcentra, will reverse anticoagulation within minutes as opposed to hours. However, its effects can wear off so it should always be given along with vitamin K, which has delayed onset but sustained effect. In life-threatening situations, administer vitamin K 10mg IV at a rate of 1mg/min to minimize the risk of anaphylaxis. Check the INR level thirty minutes after PCC is given and administer a second dose if needed. In summary: the best answer for reversing anticoagulation in warfarin-associated intracerebral hemorrhage is PCC + vitamin K. If PCC is not available, use FFP + vitamin K.
 - ▶ Warfarin-induced skin necrosis can occur (most often in middle aged obese females); seen more often in those who are given a large loading dose of warfarin to start with. Lesions typically start 3-10 days after starting the medication.



INR	Bleeding	Treatment
Normal to < 5	No	Hold one dose of warfarin and resume when level is normal
5 – 9	No	Hold one or two doses of warfarin and consider a dose of oral vitamin K
> 9	No	Hold warfarin and give oral vitamin K
Any	Life-threatening	Hold warfarin and give IV vitamin K; consider FFP

For instance, if a patient has an INR of 8 but is asymptomatic and not bleeding, options are to hold warfarin for 48 hours or to hold one dose and administer vitamin K 2.5mg orally. The patient should be instructed to have a

follow-up INR level checked.

Sickle Cell Anemia

What is the classic first presentation of sickle cell in children?

Dactylitis – swelling of the hands and feet at age 6-9 months

Why do vaso-occlusive crises occur (also known as ‘sickle cell crisis’)?

Sludging of sickled RBCs causes obstruction and subsequent ischemic pain that is precipitated by cold weather, high altitude, infection, and dehydration.

What is the leading cause of death in sickle cell patients?

Acute chest syndrome – a type of occlusive crisis defined as a new infiltrate on x-ray plus at least one of the following: hypoxia, tachypnea, respiratory distress, chest pain, cough, wheezing. If you’re asked this question on an exam, the correct answer might also be ‘pneumonia’ or ‘sepsis’.

Are there any medications that can help prevent acute chest syndrome?

Hydroxyurea is the only medication shown to be preventative. Once patients are diagnosed, antibiotics should be started immediately. Other treatments include bronchodilators for wheezing, incentive spirometry to prevent atelectasis, and transfusion for mild cases (exchange transfusion for moderate or severe cases).

What is the most common cause of osteomyelitis in sickle cell patients?

- A) *S. aureus*
- B) *S. pneumococcus*
- C) *Salmonella*
- D) *Enterobacter*
- E) *H. influenzae*

Answer: C

Explanation: Osteomyelitis can be difficult to distinguish from vaso-occlusive pain. Salmonella is the most common cause of osteomyelitis, S. aureus is #2.

Patients can get splenic infarctions and auto-splenectomy – what are the consequences?

It's important to maintain vaccinations against encapsulated organisms

Are patients at higher risk for anything else?

Priapism is a sustained, painful erection that is treated by aspirating blood from the corpus cavernosum followed by an injection of phenylephrine. For patients with acute ischemic stroke, exchange transfusion is the ideal management (avoid tPA).

Patients in vaso-occlusive crises will usually have anemia and high reticulocyte counts. What if they have anemia and *low* reticulocyte counts?

Be worried about an aplastic crisis! It can be associated with infections including parvovirus B19 and is usually self-limited.

What if they have anemia and high reticulocyte counts with abdominal pain?

Be worried about splenic sequestration – an acute drop in hemoglobin as sickled cells become trapped there. Patients may develop hypovolemic shock and even die - treatment is transfusion and plasma exchange. Up to 50% of patients will have recurrent sequestration so the spleen is often removed if patients survive.

- **Hemophilia**

- ▶ Hemophilia A: factor VIII deficiency; x-linked recessive disease
- ▶ Hemophilia B: factor IX deficiency; x-linked recessive disease
- ▶ Hemophilia A and B are clinically indistinguishable
- ▶ Bleeding can occur anywhere; most commonly into joints causing hemarthroses

Always treat trauma cases with factor BEFORE sending the patient to CT!

Also, every patient with hemophilia A who suffers head trauma should receive factor VIII whether or not there is evidence of intracranial bleeding as the risk of delayed bleeding is high. The most common cause of death is from head trauma causing hemorrhage.

Factor VIII: 18u/kg for mild, 25u/kg for moderate, **50u/kg for severe** or CNS bleeding

Factor IX: **100u/kg for severe** bleeding

Each unit of factor VIII leads to a 2% rise in plasma levels

Early hemarthroses target: 30-40% factor level

Severe muscle hematomas or dental surgery prophylaxis: target 50%

Intracranial or intra-abdominal hemorrhage: target 80-100%

As an example, let's say a patient with hemophilia B is in an MVA and hit his head on the steering wheel. CT scan of his brain is negative. He should *still* receive 100u/kg of factor IX as he is at risk for delayed bleeding. Don't take hemophilia patients lightly!

ONCOLOGY

- Spinal Cord Compression is most often associated with multiple myeloma, lymphoma, or prostate cancer and is most common in the thoracic spine
 - ▶ Pain is the first symptom and bowel/bladder dysfunction is a late finding (urinary retention leading to **overflow incontinence**)
 - ▶ MRI is the imaging test of choice
 - ▶ Treatment: steroids (high dose steroids are reserved for those patients with paresis due to side effects)

What is the most common cause of pericardial tamponade?

- A) Malignancy
- B) Trauma
- C) Parapneumonic effusion
- D) Pericarditis

Answer: B

Explanation: Malignancy is the #1 cause of non-traumatic pericardial tamponade. Beck's triad of JVD, hypotension, and muffled heart sounds is classic but not very practical due to difficulty in appreciating muffled sounds in the ED. Breast and lung cancer are frequent culprits. Treatment is pericardiocentesis/pericardial window.

Any patient that presents with 'facial swelling' and shortness of breath should have a chest x-ray done to look for a mass compressing the SVC causing obstruction. Most patients will have an abnormal chest x-ray, but CT chest with contrast is the best test for diagnosis. Non-small cell lung cancer is the #1 malignant cause.

Hypercalcemia can be associated with breast and lung cancer, multiple myeloma, and bony metastases (amongst others). For those of you who skipped the 'electrolytes' section of the cardiology chapter, let's review: the most common cause of hypercalcemia is hyperparathyroidism. Symptoms can be summarized by the fun rhyme: stones, bones, groans, and psychiatric overtones. EKG will show a shortened QT interval; initial treatment is normal saline and steroids.

Small-cell lung cancer can lead to ectopic secretion of ADH producing SIADH: hyponatremia, low serum osmolality, and normovolemia

- Hyperviscosity Syndrome
 - ▶ Increased blood viscosity leading to spontaneous bleeding, retinopathy, seizures, or even coma
 - ▶ Can occur secondary to multiple myeloma, polycythemia, or

leukemia

- ▶ Treatment: plasmapheresis for multiple myeloma, leukapheresis for leukemia, phlebotomy for polycythemia

- **Deep Vein Thrombosis**

- ▶ Virchow's triad: venous stasis, hypercoagulability, endothelial injury
- ▶ Spontaneous upper extremity DVT is rare and usually due to anatomic abnormalities of the thoracic outlet leading to compression of the subclavian vein (aka Paget-Schroetter disease). It's seen most often in young healthy people who practice yoga or other upper body exercises.
- ▶ Phlegmasia cerulea dolens = massive iliofemoral thrombosis causing ischemic occlusion that involves most of the collaterals
- ▶ Phlegmasia alba dolens = massive iliofemoral thrombosis associated with arterial spasm; no ischemia as collaterals are patent

- **Carcinoid Syndrome**

- ▶ Serotonin-secreting tumor
- ▶ Symptoms: flushing, secretory diarrhea, abdominal cramps
- ▶ 50% of patients will develop a secondary restrictive cardiomyopathy caused by serotonin-induced fibrosis
- ▶ Best initial diagnostic test: 24-hour urine for 5-HIAA levels
- ▶ Carcinoid crisis is a life-threatening form that results from the release of an overwhelming amount of biologically active compounds from the tumor
- ▶ Treatment: octreotide

- **Tumor Lysis Syndrome (TLS)**

- ▶ Release of large amounts of potassium, phosphate, and uric acid into the bloodstream
- ▶ Findings include hyperkalemia, hyperphosphatemia, hyperuricemia, and hypocalcemia
- ▶ Most often occurs 12-72 hours after chemotherapy in patients with high grade lymphomas (non-Hodgkins and ALL)
- ▶ Treatment: fluids, fluids, fluids

- ▶ Correct underlying electrolyte disorders but use caution in administering calcium as you want to avoid calcium-phosphate precipitation
- ▶ Alkalinization of urine is controversial and only recommended in severely acidotic patients
- ▶ *Rasburicase* (don't laugh – this has actually been sighted on the exam!) should be given as prophylaxis for those at *high risk*. It's administered as an initial single dose with repeated doses depending upon serum uric acid levels. It can also be used as treatment in those with established TLS.

RHEUMATOLOGY

Which of the following findings on synovial fluid analysis most strongly suggests a septic joint?

- A) Differential showing PMNs 40%
- B) WBC count of 10,000/mm³
- C) Synovial fluid glucose level of 20
- D) High serum levels of LDH

Answer: C

Explanation: Patients that present with a monoarticular arthritis should be presumed to have a septic joint until proven otherwise. The only true contraindication to performing arthrocentesis is when there is concern for an overlying skin infection as inserting a needle through infected skin can potentially introduce that infection into the joint. Glucose levels are typically very low (<25) in infectious cases.

Arthrocentesis – joint fluid analysis

	Normal	Noninflammatory	Inflammatory	Septic
Clarity	Transparent	Transparent	Cloudy	Cloudy
Color	Clear	Yellow	Yellow	Yellow
WBC/mL	< 200	> 200-2000	200-50,000	> 50,000
PMN %	< 25%	< 25%	> 50%	> 50%
Culture	Negative	Negative	Negative	Often positive
Crystals	None	None	Multiple or none	None

► **Septic Arthritis**

- ◆ Most common organism overall: *S. aureus*
- ◆ *Most joints become infected by hematogenous spread rather than direct inoculation*
- ◆ IV drug users can have involvement of sternoclavicular joints, SI joints, vertebrae, ribs
- ◆ Intra-articular antibiotics are not recommended

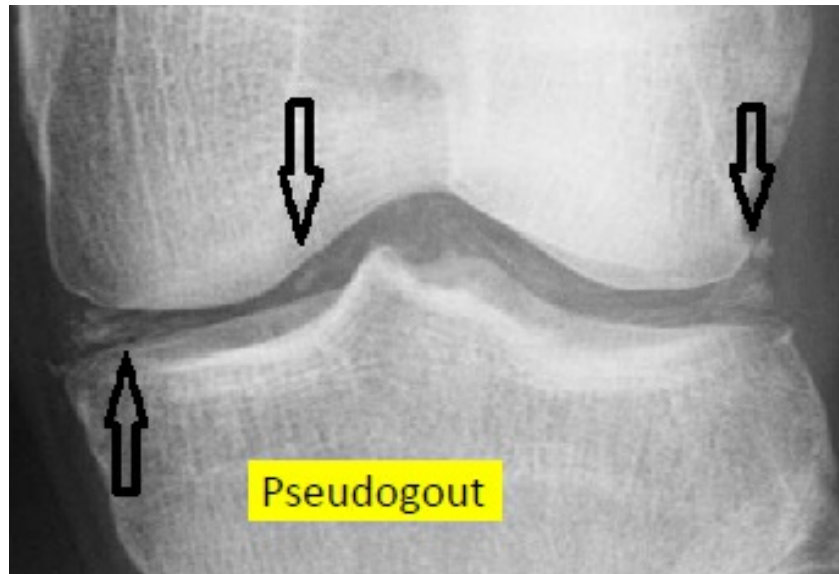
► **Inflammatory Arthritis**

Gout

Monosodium urate crystals
Great toe is most common joint
X-ray usually negative
Treatment: NSAIDs, colchicine, steroids
Chronic treatment: allopurinol, probenecid

Pseudogout

Calcium pyrophosphate crystals
Knee is most common joint
X-ray shows calcifications in joint
Treatment: same
No chronic treatment



Knowledge bomb! Women overall have a decreased risk of developing gout – but in those that do, it's in their post-menopausal years (due to estrogen's effect on renal excretion of uric acid)

All of the following are true regarding the treatment of acute gout EXCEPT?

- A) In patients with a history of peptic ulcer disease, colchicine use is indicated
- B) Colchicine is contraindicated in patients with significant liver disease
- C) Colchicine can induce peripheral neuropathies which are reversible
- D) Colchicine can safely be given IV in patients who are vomiting
- E) All of the above are true

Answer: D

Explanation: NSAIDs are first-line treatment for acute gout. In patients with NSAID intolerance or other contraindications, colchicine use is recommended. It is contraindicated in patients with severe renal or hepatic disease. While the most common side effects are gastrointestinal, colchicine use can lead to peripheral neuropathies which are rapidly reversible. Colchicine should never be given intravenously as there is a risk of serious adverse effects, including death.

What if patients are on anticoagulants?

Avoid NSAID use and either prescribe low-dose colchicine or oral glucocorticoids if there is polyarticular involvement.

Disseminated Gonococcal Infection	vs	Reiters Syndrome
Only 25% of patients will have GU symptoms Presents as EITHER 1. arthralgias, tenosynovitis, and dermatitis or 2. purulent arthritis without skin findings 50% of patients will have negative synovial fluid cultures - thus, patients should have synovial, skin, urethra, and rectal cultures N. gonorrhea is the most common cause of septic joints in patients < 30 years of age Treatment: ceftriaxone 1gram IM/IV every 24 hours until clinical improvement is noted and dosage can be changed		One of the HLA-B27 seronegative spondylarthropathies <i>Reactive arthritis</i> Classic triad: arthritis, urethritis, conjunctivitis No skin findings typically Follows an infection (usually urethritis/cervicitis) Check urinalysis, swab for Chlamydia, stool sample Does not respond to antibiotics; treatment is NSAIDS (indomethacin for instance)

- **Lyme Disease**

- ▶ 3 stages of infection:

- ◆ Early (localized): the 'target' rash (erythema migrans) may or may not be present. If it is, treat with doxycycline for 21 days. Serologic tests are not indicated at this stage as titers will be negative.
 - ◆ Early (disseminated): manifestations include cardiac (AV block), neurologic (meningitis or bilateral facial nerve palsy), or musculoskeletal (severe monoarticular arthritis). Serologic tests should be performed and patients may need IV antibiotics.
 - ◆ Late: occurs months to years later

For some reason, examiners like asking questions about lupus:

- **Systemic Lupus Erythematosus (SLE)**

- ▶ Autoimmune disease mostly affecting young women
 - ▶ Symptoms/signs: fever, joint pain, rash, strokes, seizures, psychosis, peri/myo carditis, effusion, tamponade, pleurisy, pulmonary infarction, pneumonitis, vasculitis, anemia, thrombocytopenia, nephritis, nephrotic syndrome, etc, etc, etc
 - ▶ Seizures are the most common neurologic manifestation

- ▶ ANA is the most sensitive test
- ▶ Anti-Sm is the most specific test
- ▶ Characteristic butterfly rash
 - ◆ Erythema over the cheeks and bridge of the nose
 - ◆ Present in 50% of cases of SLE
 - ◆ May last for hours or days and often recurs, especially with sun exposure
 - ◆ May precede other symptoms by months or even years or may be accompanied by other symptoms of acute SLE



- ▶ **Discoid lupus**
 - ◆ Variant that can occur independently or as part of SLE
 - ◆ Raised scaly plaques that are well-defined and primarily on head, face, and neck
 - ◆ Treatment: limit sun exposure, topical steroids



- ▶ Pregnancy should be avoided in cases of active lupus and women should be advised to not become pregnant until remission for at least 6 months
- ▶ Procainamide and hydralazine are associated with drug-induced

lupus, which is reversible once the offending agents are stopped

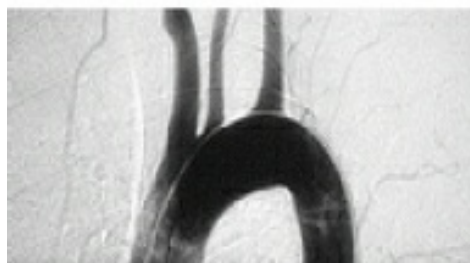
- ▶ Treatment: systemic steroids and immunosuppressive medications (methotrexate) are reserved for patients with multi-organ involvement (renal/CNS disease)

We briefly discussed the ‘lupus anticoagulant’ above when talking about causes of a prolonged aPTT. Remember that lupus is a PRO-thrombotic process with patients at much higher risk of developing a clot. Most patients with lupus actually don’t have the lupus anticoagulant, and many patients who have the lupus anticoagulant don’t have lupus. Confused yet?

- Rheumatoid Arthritis (RA) is a polyarticular and symmetric arthritis. Some patients can be seronegative with negative RF levels (these patients tend to have milder disease).
- Thromboangiitis obliterans (Buerger’s disease) and Takayasu’s arteritis are frequently mentioned together because both are thought to have an underlying autoimmune component to them. Both are frequently seen in Asian countries. But Takayasu’s primarily affects young Japanese women while Buerger’s affects middle-aged men. Buerger’s is a chronic vasculitis affecting the hands and feet (Raynaud’s phenomenon: they turn pale when exposed to cold). Takayasu’s is a chronic vasculitis affecting the aorta (and may result in pulseless extremities).

To take it one [unnecessary] step further, Takayasu’s should not be confused with Takotsubo’s (aka ‘Broken Heart Syndrome’). Takotsubo’s is a type of non-ischemic cardiomyopathy in which there is a sudden reduction in EF triggered by an emotional event or stress.

Normal aorta



Takayasu's aorta



Let's take a moment to review HIV -

The three stages of HIV are

- 1 – Acute infection
- 2 – Chronic infection
- 3 – AIDS

HIV can be transmitted during any of these stages, but the risk is highest during 'acute infection' – this is an important fact to remember and has been known to show up on exams. Viral titers are high during this stage and, since many patients may not even know they have HIV yet, transmission rates are high.

During the acute infection phase, patients may be asymptomatic but the majority have nonspecific symptoms such as fever, malaise, headache, etc. The classic presentation is abrupt onset of a viral illness which occurs 10-14 days after exposure to HIV.

Once the body develops antibodies (aka 'seroconversion') the patient is considered to have moved on to the chronic stage of infection. This stage can last months to years and persists until the CD4 count drops below 200 (or the patient has an AIDS- defining illness) at which point the patient has AIDS.

What are the AIDS-defining illnesses? You might be given a list and asked to pick one. Esophageal candidiasis (not just oral candidiasis), Cryptococcus, Cryptosporidium, CMV, encephalitis, HSV, Mycobacterium, PCP pneumonia, recurrent bacterial pneumonia (more than 2 episodes in a 12 month period), and Toxoplasmosis. There are also three malignancies that are considered AIDS-defining: invasive cervical cancer, Kaposi sarcoma, and lymphoma.

A random fact to be aware of: for unclear reasons, persons with HIV have a 4x higher risk of developing a DVT.

Once antiretroviral therapy is started, there is a condition known as IRIS (immune reconstitution inflammatory syndrome) in which the CD4 count will improve and viral loads will fall, but there can actually be a worsening of the

condition. If this occurs, patients may be susceptible to develop an opportunistic infection. HAART therapy should continue despite this.

The following CD4 counts are considered guidelines for initiating prophylaxis:

< 200 : PCP

< 150 : Histoplasmosis if high-risk exposure

< 100 : Toxoplasmosis

< 50 : Mycobacterium avium complex (MAC)



**NEPHROLOGY &
GENITOURINARY**

ACUTE RENAL FAILURE

I. Prerenal

- ◆ Reduced renal perfusion from either hypovolemia or hypotension (cardiogenic)
- ◆ Treatment is to restore circulating volume

II. Renal

- ◆ Intrinsic disease
- ◆ Causes include ATN (most common), vascular (dissection, thrombosis, embolism), glomerular (RPGN), interstitial

III. Postrenal

- ◆ Obstruction
- ◆ Causes include BPH (most common)

- Two main types of nephritic syndrome:

1) **Rapidly Progressive Glomerular Nephritis (RPGN)**

Immune complexes/antibodies in glomeruli

Crescent formation in glomeruli: severity of disease is in part related to degree of crescent formation

UA: RBC casts

Untreated it can lead to ESRD

Treatment: steroids

2) **Post-Strep Glomerulonephritis**

Treatment: antibiotics (penicillin, just like strep pharyngitis)

Mostly self-limited; in rare cases can progress to ESRD

- **Acute Interstitial Nephritis**

- ▶ Immune mediated
- ▶ Causes include drugs (penicillin, sulfa, quinolones, diuretics, NSAIDs), infection, and immune/neoplastic disorders
- ▶ Symptoms/signs: fever, rash, arthralgias, eosinophilia
- ▶ Typically occurs 3-5 days after drug exposure but may be as long as 18 months later

- ▶ UA: WBC casts, eosinophiluria
 - ▶ Diagnosis: renal biopsy
 - ▶ Treatment: removal of offending agent and/or treat the underlying cause
- **Acute Tubular Necrosis (ATN)**
 - ▶ #1 cause of renal failure
 - ▶ Result of prolonged renal ischemia and will not necessarily respond to IV fluids (distinguishing it from prerenal disease)
 - ▶ UA: muddy brown granular and epithelial cell casts

To summarize...

ACUTE RENAL FAILURE		
Urinalysis	Location of Pathology	Etiology
RBC casts	Glomerular disease	Nephritic syndrome (RPGN)
WBC casts	Interstitium	Interstitial nephritis, pyelo
Eosinophils	Interstitium	Interstitial nephritis
Granular casts	Tubule	ATN
Hyaline casts	Pre or post renal	Pre or post ARF

All of the following are true regarding rhabdomyolysis except:

- A) CPK levels correlate with acute renal injury
- B) Myoglobin is only detected in the urine in 50% of cases
- C) The target urine output for someone with rhabdomyolysis and acute renal injury is 200 mL/hr
- D) Patients suffering from rhabdomyolysis may develop hyperkalemia as a result

Answer: A

Explanation: Rhabdomyolysis is defined as muscle necrosis and the release of its byproducts into the circulation. It can result from trauma, crush injuries, burns, or heat stroke amongst others. Influenza and Legionella are the most common infectious causes. Myoglobinuria is present in only about 50% of cases (myoglobin results in a positive heme dip but *no RBCs on the micro*). CPK levels are increased $> 5\times$ normal but don't correlate with acute renal injury. Hyperkalemia, hyperphosphatemia, and hypocalcemia may result. Treatment is IV fluids and the target urine output for someone with rhabdo and acute renal injury: 3mL/kg/hr or 200mL/hr.

- **Contrast-induced Nephropathy**

“I don't understand why the radiology tech is so worried about giving this patient contrast – his creatinine is only 1.3...”

Look at the GFR and not the creatinine! Anyone with a $GFR < 60$ is at risk for contrast-induced nephropathy. Other patients at risk include the elderly, diabetics, and hypotensive patients. Treatment is to give fluids before and after the study. Remember to hold metformin for 48 hours in diabetic patients.

All of the following are indications for emergent dialysis except:

- A) Hyperkalemia
- B) Elevated BUN levels
- C) Toxic overdose of salicylate
- D) $pH < 6.9$
- E) Pulmonary edema
- F) None of the above – all are indications for emergent dialysis

Answer: D

Explanation: A mnemonic for the indications for emergent dialysis is

AEIOU:

Acidosis (refractory)

Electrolyte abnormalities

Ingestion
Overload Uremia

Which ingestions? **I-STUMBLED**

Iron/INH, Salicylates, Theophylline, Uremia, Methanol, Barbiturates,
Lithium, Ethanol/ethylene glycol, Depakote

CHRONIC RENAL FAILURE / CHRONIC KIDNEY DISEASE (CKD)

- **Polycystic Kidney Disease**

What is it? An inherited disease that can lead to irreversible renal failure

How is it diagnosed? CT scan will show bilaterally enlarged kidneys with multiple cysts

Prognosis? Renal function characteristically remains intact until the 4th decade of life. Most patients will die from cardiac causes and there is no specific treatment to slow progression

Co-existing conditions? Almost 100% of patients will have associated HTN; ACE inhibitor is the first-line antihypertensive of choice. It is classically associated with abdominal wall hernias, intracranial aneurysms, and UTIs.

In a hyperkalemic patient, which of the following is the only treatment that will actually remove extra potassium from the body?

- A) Calcium gluconate
- B) Sodium bicarbonate

- C) Insulin
- D) Beta-agonists
- E) Kayexalate
- F) Calcium carbonate

Answer: E

Explanation: Calcium is best used to stabilize the cardiac membrane so it is the most important early treatment. Insulin helps drive potassium into cells, as does sodium bicarbonate. Beta agonists offer more of a theoretical benefit, requiring higher doses than are almost ever typically given. Kayexalate, also known as sodium polystyrene sulfate, exchanges sodium for potassium and is the only treatment that actually removes potassium from the body. It is contraindicated in cases of CHF as the serum sodium level will rise. Dialysis is the final option and of course does remove potassium from the body as well.

- **Vascular Access Complications**
 - ▶ High-output heart failure
 - ◆ Large portion of arterial flow is shifted from left-sided circulation to the right side causing increased preload and cardiac output and subsequent heart failure
 - ◆ **Exam finding: occlusion of the AV fistula leads to bradycardia**
 - ◆ Treatment: fix the underlying problem (surgical banding or ligation) If symptoms remain after maximum medical therapy (diuretics, dialysis, BP control, etc):
 1. close any unused AV fistulas
 2. reduce blood flow of the fistula that is being used
 3. close the fistula and place a tunneled catheter
 - ▶ Bleeding: hold direct pressure; consider protamine sulfate for heparin reversal and topical thrombin with gelfoam
 - ▶ Steal Syndrome
 - ◆ Typically presents a few hours to days after placement of an AV fistula
 - ◆ Patients have significant stenosis in an artery distal to the fistula and don't develop adequate collaterals

- ◆ Symptoms include paresthesias, cold extremities, loss of pulse
- ◆ Symptoms typically worsen during dialysis
- ◆ Treatment: immediate surgical intervention
- ▶ Infection: **S. aureus is most common** (S. epidermidis is #2).
Treatment of choice is vancomycin.
- ▶ Graft stenosis or thrombosis
 - ◆ Most common vascular access complication
 - ◆ Gold standard for diagnosis is angiogram
 - ◆ Treatment: immediate surgical intervention, thrombolytics if needed

Peritoneal Dialysis – what’s so great about it?

Patients don’t require any heparin to keep their line open and there are fewer complications

What’s the most common complication?

Peritonitis

That sounds bad! How will I know if my patient has it?

Patients will present with abdominal pain and fever. If you can analyze some of the peritoneal fluid you will find WBC > 100 with lots of PMNs.

Treatment is intraperitoneal antibiotics (unless septic – then use IV)

Any other complications to worry about? Abdominal wall hernias can be a problem

URINARY TRACT INFECTIONS

- Acute cystitis – infection of the bladder (lower urinary tract)
Symptoms: dysuria, frequency, urgency, hematuria

- Acute pyelonephritis – infection of the kidney (upper urinary tract)
Symptoms: cystitis + fever, flank pain, vomiting

All of the following groups of patients should receive a urine culture except:

- A) A 2 year old with fever but negative urinalysis
- B) A 25 year old pregnant woman with asymptomatic bacteremia
- C) A 40 year old man with a urinary tract infection
- D) None of the above need a culture sent
- E) All of the above need a culture sent

Answer: E

Explanation: All female patients aged 3-24 months with a fever and no known source should receive a urine culture, regardless of the urinalysis findings. All men with a UTI should have cultures sent. Regarding treatment, IDSA guidelines list nitrofurantoin (macrobid) for five days as first-line treatment, and trimethoprim/sulfa (bactrim) for three days as a reasonable alternative. Nitrofurantoin is preferred due to lower inherent resistance.

- Cystitis is much less common in men than in women due to:
 - ▶ Longer urethral length
 - ▶ Drier periurethral environment
 - ▶ Antibacterial substances in the prostatic fluid
- Bacteremia has a higher chance to progress to pyelonephritis in pregnant women (this is why you treat all pregnant women even if they have asymptomatic bacteremia)

Which of the following is the most likely causative organism of prostatitis in a 38 year old male?

- A) E. coli
- B) N. gonorrhoeae
- C) Pseudomonas
- D) S. saprophyticus

Answer: A

Explanation: Prostatitis typically occurs in young and middle aged men.

Symptoms include fever, chills, dysuria, and pelvic/perineal/rectal pain.

While there may be pyuria, there is an absence of hematuria. On exam the prostate is firm, edematous, and exquisitely tender. The most likely organism in men under the age of 35 is gonorrhea/chlamydia, while in men over the age of 35 it is E. coli. Risk factors include multiple sexual partners, unprotected anal intercourse, and BPH.

Chronic bacterial prostatitis can develop following an episode of acute prostatitis.

Prostatitis should be treated with antibiotics for a minimum of four weeks but the ideal regimen is SIX weeks of antibiotics

S. saprophyticus is the second most common cause of UTI in adolescent females (E. coli is number one). It's often seen within 24 hours of sexual intercourse and is therefore known as 'honeymoon cystitis'.

Here's a **classic scenario** that would make an excellent question: A patient with a chronic **indwelling foley** presents with **hematuria** and signs of **urinary obstruction**. Bladder irrigation yields red-tinged urine. Now what? Foleys can be complicated by formation of a blood clot within the catheter that prevents drainage. This can lead to suprapubic pain, distension, and urinary retention. ED management is **continuous bladder irrigation** via a three-way catheter.

NEPHROLITHIASIS

No blood in the urine. I guess that means no kidney stone right?

Wrong! Hematuria is present 80% of the time – so 1/5 patients will have no blood

What are the four types of stones?

Calcium, struvite, uric acid, and cysteine

Which is most common and how do you treat them?

Calcium stones are most common. Treatment includes increasing fluid intake and using tamsulosin (flomax) as an alpha blocker that improves urinary flow. Calcium channel blockers and corticosteroids have shown some benefit as well.

Is there a way to prevent calcium stones?

Aside from diet (more on that below), thiazide diuretics decrease urinary calcium excretion and can be used to prevent stones from forming.

What's so special about struvite stones?

They form staghorn calculi and are associated with proteus infections. They are also found in characteristically high urine pH.

What's unique about uric acid stones?

They are radiolucent so won't show up on plain radiographs. Also, allopurinol can help reduce formation of uric acid stones.

And cysteine stones?

They are associated with inborn errors of metabolism and are the rarest type

Knowledge bomb! Indinavir is used in the treatment of HIV and can cause stones – the stones are actually crystallized particles of the drug itself (and therefore also radiolucent); lithotripsy is ineffective and stenting is the procedure of choice

- **Sites of impaction:**
 - ▶ Ureterovesical junction (narrowest part of the ureter)
 - ▶ Renal calyx Ureteropelvic junction
 - ▶ Pelvic brim
- **Imaging:**
 - ▶ KUB is neither sensitive nor specific
 - ▶ Ultrasound is more specific but not very sensitive

- ▶ Ultrasound is the diagnostic test of choice in pregnancy
- ▶ CT without contrast is the most sensitive and specific

Which of the following dietary recommendations should be made to someone with a kidney stone?

- A) Increase intake of orange juice and lemonade
- B) Increase consumption of red meat
- C) Vitamin C supplements
- D) High-salt diet to stimulate thirst and subsequent water intake
- E) Limit soda intake to less than 2 liters per week

Answer: A

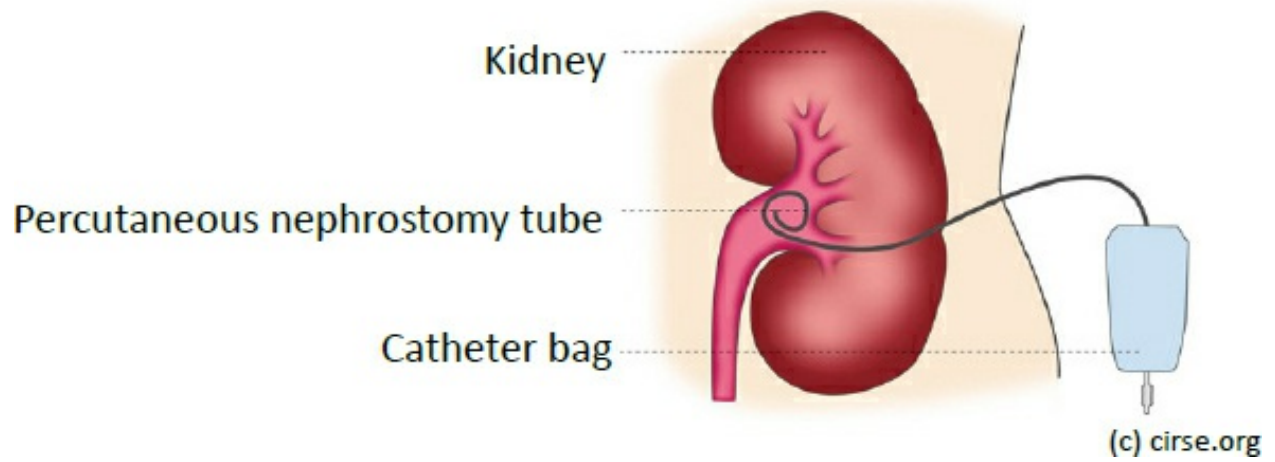
Explanation: Lemonade and orange juice are citrate-rich. Citrate binds to calcium in the urine, preventing it from binding to oxalate or phosphate and forming stones. Cranberry juice on the other hand, while good for preventing UTIs, contains oxalates and should be avoided. Soda consumption should be less than one liter per week.

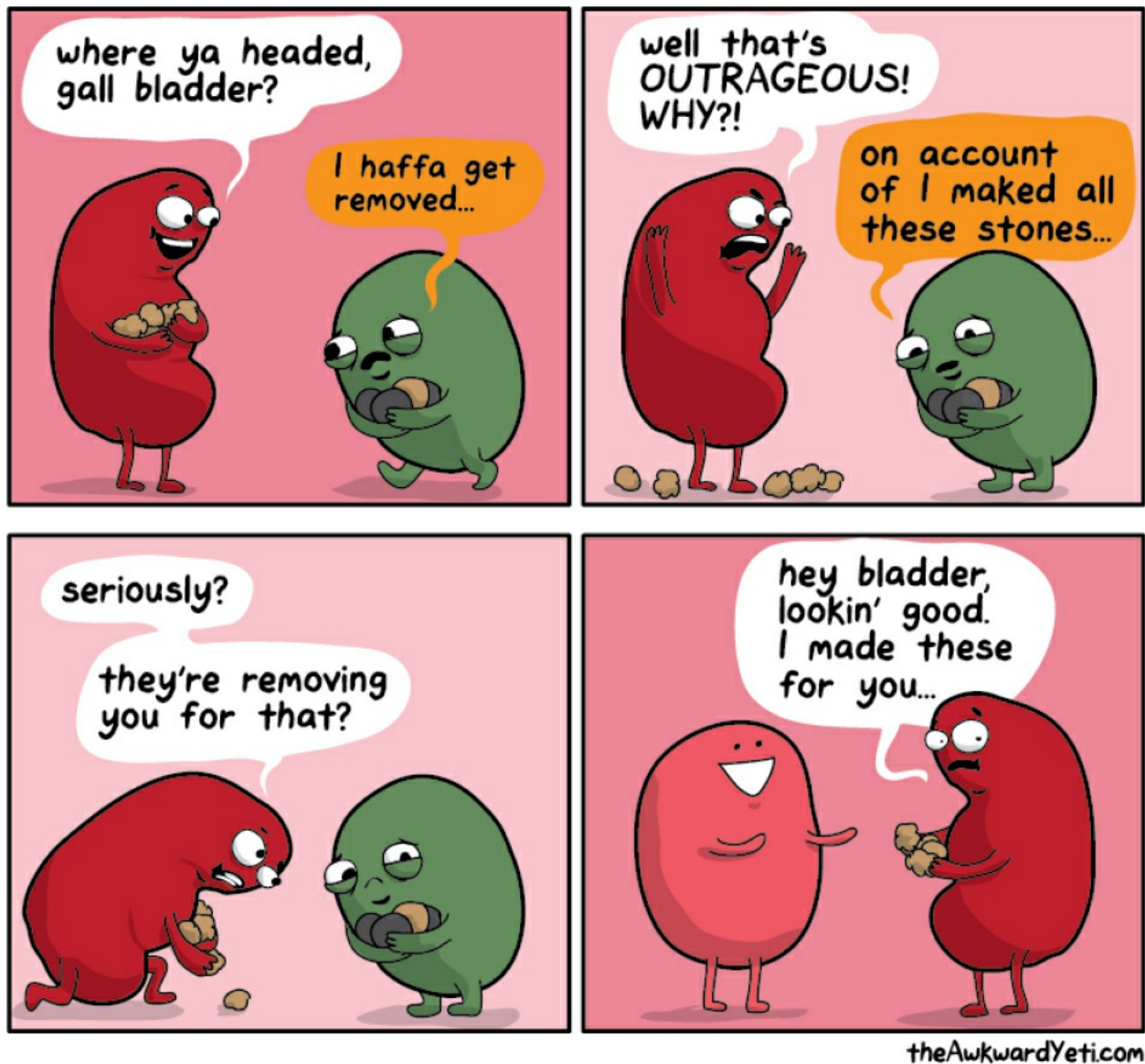
- Stones < 5mm in size pass spontaneously 90% of the time
- Stones > 1cm in size pass spontaneously 10% of the time

Alpha blockers (tamsulosin/flomax) can be used to facilitate propagation of stones through the ureters and theoretically reduce pain and ER return visits. There aren't any *good* randomized controlled trials showing benefit, but these medications act by causing ureteral relaxation. Since most alpha receptors are in the distal ureter, distal ureteral stones are the ones that will benefit the most. Also, stones < 5mm in size are most likely to show some benefit.

Let's take the scenario of an elderly patient who presents with **severe sepsis and flank pain**. Remember that anyone with an obstruction caused by a kidney stone can develop a superimposed infection. Sepsis in conjunction with an obstructing stone is a true emergency. The collecting system should be urgently decompressed (**percutaneous nephrostomy tube** or ureteral stent). Definitive treatment of the stone (lithotripsy for instance) should be

delayed until sepsis is resolved.





OTHER DISORDERS OF THE GENITOURINARY SYSTEM

- Consider Fournier's Gangrene in any patient with scrotal, rectal, or genital pain out of proportion to exam – it's a polymicrobial infection

which starts out looking benign and quickly becomes a surgical emergency

- ▶ More common in immunosuppressed patients: diabetic, IV drug users, alcoholics

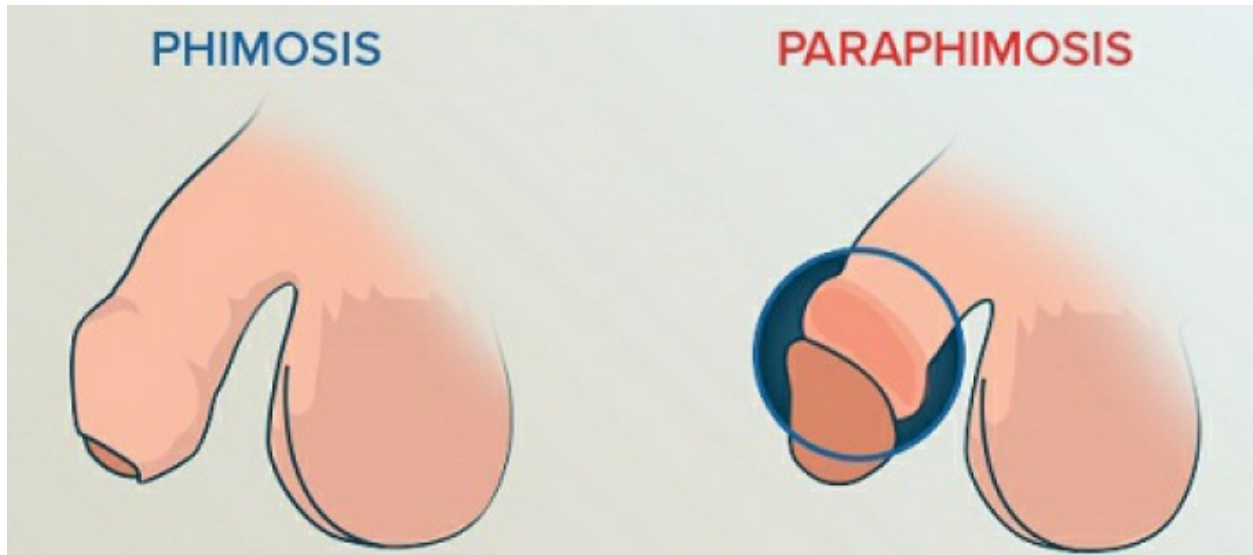
You examine a 30 year old uncircumcised male patient with foul smelling exudate on his glans. Which of the following is the next best step?

- A) Urine culture
- B) Blood culture
- C) Glucose level
- D) CBC and blood culture
- E) Culture of the exudate

Answer: C

Explanation: Balanoposthitis (balanitis = glans penis, posthitis = foreskin) usually results from poor personal hygiene in uncircumcised men. If suspected, the first test to order is a fingerstick glucose to check for diabetes. Treatment consists of local care (soap/water, keep area dry), topical bacitracin, and topical clotrimazole. If left untreated it can lead to edema and subsequent phimosis.

Phimosis	Paraphimosis
Inability to retract foreskin	Retracted foreskin that cannot be brought back
Rarely emergent	Emergency
Can lead to urinary retention	Can lead to necrosis
Treatment: if retention, dilate ostium; patients may need circumcision	Treatment: ice, manual reduction, or incision; patients can be discharged home if able to void



- **Physiologic phimosis can occur in uncircumcised males** and should resolve on its own; 99% of phimotic foreskins retract when children enter their teenage years
- **Fractured Penis** can occur during forceful sexual intercourse due to rupture of the tunica albuginea; most cases require surgical management
- **Penile Hair Band** is a constricting hair band that can be seen in infants; it should be considered in the differential of a ‘fussy baby’
- **Priapism**

What is it? A pathologic sustained erection that can lead to urinary retention and impotence

Who gets it? It is associated with sickle cell disease, trauma (straddle injury), and medication side effects

That seems straightforward – but test questions never are. What might they ask? There are two types of priapism: low flow (also called ‘veno-occlusive’) and high flow (also known as ‘arterial’). Most cases are veno-occlusive, which results from sluggish blood flow in obstructed veins. Arterial (aka high flow) is rare and can result from direct injury to the penis itself or from a spinal cord injury.

How is priapism treated? For low flow, administer terbutaline 0.5mg SQ in the deltoid. Aspirate blood from the corpus cavernosum and inject phenylephrine in the same area. DO NOT do this if the patient has high flow priapism as it can lead to severe hypertension.

Summary of priapism

Types:	Ischemic aka low-flow aka venoocclusive	Arterial aka high-flow
Physical exam:	Fully rigid, painful	Less rigid and painful
ABG:	Deoxygenated blood	Oxygenated blood
Ultrasound:	No flow or decreased flow	Normal flow
Treatment:	Aspirate 5cc of blood and inject 1cc of 100mcg phenylephrine	Observe

Who is 'priapism' named after?

Priapus: Greek God of fertility

The illegitimate son of Zeus and Aphrodite and cursed by Zeus' wife Hera; he was born with oversized genitalia and subsequently rejected by Aphrodite. He was raised by shepherds, who noticed that flowers would bloom in his presence.



Which of the following is appropriate treatment for a male with yellow penile discharge and a history of unprotected sex?

- A) Azithromycin 1 gram PO
- B) Ceftriaxone 250mg IM
- C) Azithromycin 1 gram PO + levofloxacin 750mg PO
- D) Metronidazole 2 grams PO + ceftriaxone 250mg IM
- E) Azithromycin 1 gram PO + cefixime 400mg PO

Answer: E

Explanation: Azithromycin 1 gram PO + Ceftriaxone 250mg IM is the regimen typically given. Cefixime is an alternative to Ceftriaxone. Fluoroquinolones are no longer recommended due to resistance patterns. Patients who receive treatment for GC/chlamydia should refrain from intercourse for seven days.

An alternative treatment regimen used to be Azithromycin 2g PO. The CDC updated its guidelines in June 2015 and removed this over concerns of resistance. Gentamicin 240mg IM is now an acceptable alternative in patients with allergies.

- **Syphilis**
 - ▶ Primary syphilis – **5 things to know:**
 - 1) It's characterized by a painless chancre
 - 2) Treponemal vs Non-treponemal tests

Non-treponemal tests like the RPR give you an actual number and can be followed to see if a person is responding to treatment. They're very sensitive and therefore used as screening tests. *Treponemal tests* like FTA-ABS are either positive or negative and once they become positive they stay that way for a long time. They're very specific for syphilis but not as sensitive.

- 3) Tests can be negative for 4-6 weeks following infection
- 4) Treatment is a single shot of 2.4 million units of penicillin G

What if the patient has a penicillin allergy? **If they are pregnant, treatment is desensitization and still penicillin.** If not pregnant, doxycycline is drug of choice.

5) Jarisch-Herxheimer reaction: acute febrile reaction to penicillin within the first 24 hours (treat with tylenol)



Many patients who present with secondary syphilis don't report ever having a chancre

- ▶ Secondary syphilis
 - ◆ Begins 6-8 weeks after the appearance of a chancre and persists for 2-10 weeks
 - ◆ Patients have constitutional symptoms (fever, malaise, headache) and a rash involving the palms and soles



- ▶ Latent syphilis: serologic proof of infection without symptoms
- ▶ Tertiary syphilis
 - ◆ Begins after 4-7 years
 - ◆ Gummas (soft tumor-like balls of inflammation), aortitis, neurologic symptoms
 - ◆ Patients are no longer infectious

- Genital Herpes is usually associated with HSV 2 and can cause constitutional symptoms (headache, fever, myalgias), painful blisters, and lymphadenopathy; treatment is with acyclovir

A 35 year old male presents with the lesion seen below and painful lymphadenopathy. Which of the following is the most appropriate treatment regimen?



- A) Ceftriaxone 250mg IM + Azithromycin 1 gram PO
- B) Levofloxacin 750mg PO for 14 days
- C) Ceftriaxone 250mg IM + Metronidazole 500mg PO BID for 7 days
- D) Doxycycline 100mg PO BID for 21 days

Answer: D

Explanation: Lymphogranuloma Venereum is associated with Chlamydia trachomatis. It is characterized by a painless herpes-like ulcer and painful inguinal buboes (enlarged nodes). Doxycycline is the drug of choice for nonpregnant patients and should be prescribed for 21 days. The alternative is Azithromycin 1 gram PO per week for three weeks. Infected buboes should also be drained.

- Chancroid is caused by Haemophilus ducreyi and is associated with a tender papule followed by a painful ulcer (multiple lesions may be

present and coalesce) as well as painful inguinal lymphadenopathy. Treatment is azithromycin 1 gram PO or ceftriaxone 250mg IM (therefore it's routinely covered for whenever treating GC/Chlamydia).

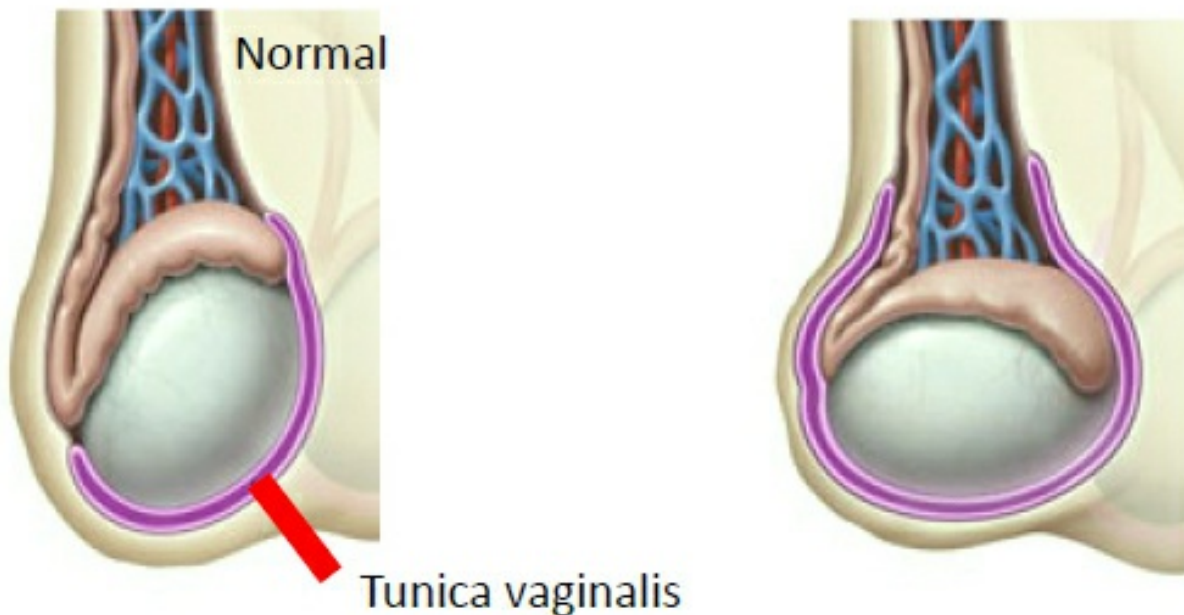


- **Testicular Torsion**

Presentation: acute onset testicular pain (usually less than 12 hours duration), nausea/vomiting. Patients may have intermittent pain if the testicle is torsing/detorsing and may report a history of similar pain in the past.

Chronic intermittent torsion may result in segmental ischemia of the testicle and warrants urgent **outpatient** urology evaluation

"Bell clapper" deformity: testicle lacks the normal attachment to the tunica vaginalis (permitting increased mobility) and lies transverse within the scrotum



In the second image above, the testis is not attached to the vaginalis, so there is increased mobility and a horizontal lie of the testicle; this deformity is typically bilateral

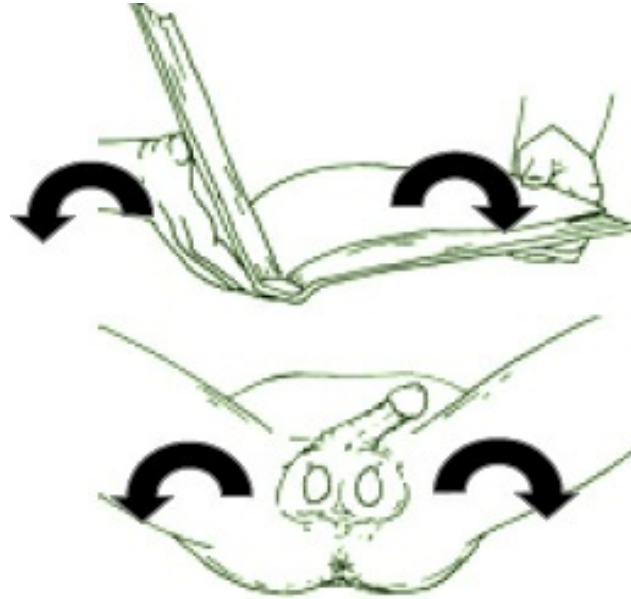
What is the most sensitive physical exam finding in patients with testicular torsion?

- A) Stroking the inner thigh fails to elevate the testicle
- B) Manually elevating the testicle provides no pain relief
- C) Displacement of the epididymis anteriorly
- D) Elevated testicle within the scrotum

Answer: A

Explanation: The cremasteric reflex is elicited by stroking the inner thigh, causing contraction of the cremaster muscle which elevates the testicle. It is considered positive if the testicle moves at least 0.5cm. Absence of this reflex is the most sensitive finding of torsion. An elevated testicle is the most specific finding. Manually elevating the testicle is known as 'Prehns sign' and this has been shown to be neither sensitive nor specific. Diagnosis is clinical. Urology should be consulted immediately; doppler ultrasound can be

done thereafter to confirm the diagnosis. Manual detorsion should be attempted (testes turned like ‘opening a book’) but definitive treatment is surgery for *bilateral* orchidopexy.



- **Epididymitis**

- ▶ More frequent in adolescents but can occur in young boys as well
- ▶ Risk factors: sexual activity, exertion, direct trauma (bicycle riding)

When diagnosed in pre-pubertal boys, consider structural abnormalities

- ▶ Sexually active males < 35 years: think chlamydia or gonorrhea
- ▶ Males who participate in anal intercourse: think E.coli or Pseudomonas
- ▶ Males > 35 years: think about bacteriuria secondary to enlarged prostate (Pseudomonas) and treat with fluoroquinolones
- ▶ Children (non-sexually active males): think **M. pneumoniae or adenovirus**
- ▶ In children, antibiotics are often unnecessary. Check for associated UTI.
- ▶ Symptoms: acute/subacute onset of pain localized to the epididymis with a normal cremasteric reflex
- ▶ Diagnosis is clinical; doppler ultrasound will show increased blood flow to the affected epididymis

- Orchitis
 - ▶ Inflammation of the testicles most often due to infection
 - ▶ Most common viral cause: mumps (others include coxsackie and rubella)
 - ▶ Can also be caused by epididymitis, prostatitis, or STD
 - ▶ Treatment: supportive (analgesics, scrotal support, etc) +/- antibiotics

- Urinary Retention
 - ▶ Prostate enlargement is the most common cause
 - ▶ Normal postvoid residual in adults is < 50 mL
 - ▶ **The first step in management is immediate placement of a foley catheter.** If for some reason this can't be done, a suprapubic catheter may be necessary. Once this is placed, consider urinalysis and ultrasound.

A patient is two months post renal-transplant and presents to the ER with a temperature of 102°F. Labs show leukopenia, anemia, and elevated AST and ALT levels. Which of the following is the most likely causative organism?

- A) *S. pneumo*
- B) *S. aureus*
- C) Influenza
- D) CMV
- E) *C. diff*

Answer: D

Explanation: Kidneys are the most common solid organ transplant and patients are prescribed high-dose immunosuppressants afterwards. **The highest risk of opportunistic infection is during the 2nd through 6th month post-transplant.** Any patient with a fever warrants a thorough workup. CMV is associated with leukopenia, anemia, and elevated liver enzymes and has a particularly high incidence during this time period.

- **Renal Transplant**

- ▶ Transplant location: retroperitoneal in pelvis
- ▶ Severe UTIs will require admission and dual antibiotic therapy – avoid nephrotoxic agents such as aminoglycosides and high dose trim/sulfa
- ▶ If patients need a blood transfusion, use leukocyte-depleted blood
- ▶ Corticosteroids can accelerate osteoporosis and increase the risk of fractures – any complaint of extremity pain should be imaged
- ▶ **ANY rise in creatinine should be evaluated**
- ▶ Immunosuppressant levels (cyclosporine, tacrolimus) need to be drawn 1-3 hours before the dose of the drug is given (trough) – so levels are not typically sent in the ER

If a patient presents one week after a renal transplant with oliguria and renal failure, the test to order is:

- A) CT without contrast
- B) CT with contrast
- C) MRI/MRA
- D) Doppler ultrasound

Answer: D

Explanation: Acute occlusion usually occurs within the first post-transplant week and causes oliguria and acute renal failure. Doppler ultrasound may demonstrate lack of blood flow, prompting surgical exploration which can salvage the allograft in a small fraction of patients with this complication. If a peri-transplant fluid collection is seen on doppler ultrasound (typically within the first month post-transplant), this can suggest a urinary leak and also requires surgical correction.



HEADACHE

Which is the most common type of migraine?

- A) Migraine with aura
- B) Migraine without aura
- C) Chronic migraine
- D) Classic migraine
- E) Ophthalmoplegic migraine

Answer: B

Explanation: Migraine without aura is also known as '*common* migraine'. It just so happens to be the most *common* type of migraine. Migraine with aura is also known as 'classic migraine'. Ophthalmoplegic migraine is a rare variant that affects CN III, IV, and VI and can lead to a fixed dilated pupil and diplopia.

There are three categories of headaches that you should be familiar with:

1) Migraine

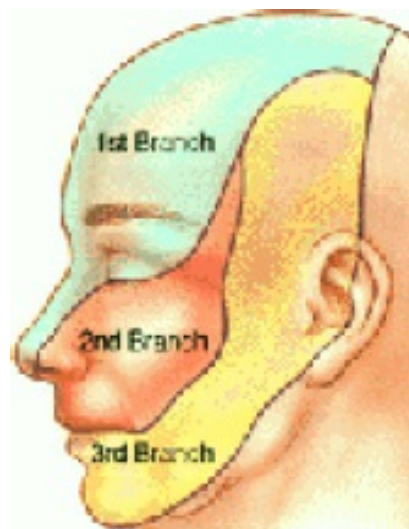
- Risk factors: female, age 10-30, positive family history
 - Unilateral throbbing pain with nausea/vomiting, photo/phonophobia
 - Treatment: triptans are first-line; triptans combined with NSAIDs are even more effective
 - ▶ Triptans can cause non-ischemic chest pain and should be avoided in patients with ischemic heart disease, stroke, HTN, or pregnancy
 - IV (not oral) antiemetics can be used as monotherapy
 - Use of opioids for pain relief is controversial
- Dexamethasone + standard abortive therapy significantly reduces headache recurrence**

2) Cluster Headache

- Unilateral and lasting 30-90 minutes
- Multiple headaches daily over several weeks
- **No prodrome or aura**; no nausea/vomiting or photophobia
- Signs: ptosis, miosis, conjunctival injection, lacrimation, rhinorrhea
- Treatment: **100% oxygen non-rebreather for 15 mins** and triptans (take- home message: oxygen via nasal cannula is *not* effective!)
- Prophylaxis: verapamil

3) Tension Headache

- Constant bilateral pain described as ‘vice-like’
- Patients don’t usually have nausea/vomiting or photophobia
- Treatment: simple analgesics like tylenol; can be combined with caffeine
- Prophylaxis: not typically necessary; evidence is strongest for amitriptyline
- **Trigeminal Neuralgia** aka ‘tic doreux’
 - ▶ Sensations of sharp, electricity-like pain in trigeminal nerve distribution with spontaneous remission
 - ▶ Can affect any branch and can affect more than one branch
 - ▶ Treatment: [carbamazepine](#), baclofen, surgical decompression
 - ▶ All patients should be referred to a neurologist for outpatient MRI (sometimes associated with underlying MS or intracranial lesion)



- Idiopathic Intracranial Hypertension aka **pseudotumor cerebri**

Impaired CSF absorption → increased CSF pressure without mass/obstruction Classic presentation: young, obese female (typically African-American) with a history of irregular menses whose chief complaint is headache (not blurry vision). On physical exam you will see **papilledema (bilateral, symmetric)**. Diagnosis is confirmed by performing an LP and noting **high opening pressure**.

Treatment: weight loss, acetazolamide, loop diuretics, therapeutic LPs to remove fluid, corticosteroids, and a shunt if necessary

Knowledge bomb! Loss of venous pulsations on fundoscopic exam is the earliest indicator of papilledema

Which of the following is true regarding concussions?

- A) Concussion, by definition, must be associated with a loss of consciousness
- B) Males are at higher risk than females
- C) Neurologic exam is typically normal
- D) Returning to normal academic activities is encouraged, while refraining from athletic activities until cleared by a healthcare professional

Answer: C

Explanation: Patients should get adequate rest and refrain from both athletic and cognitive activities. Although symptoms may include headache, dizziness, blurry vision, vomiting, and photophobia, the neurologic exam is typically normal.

- **Temporal Arteritis**
 - ▶ Elderly patient with headache and temporal artery tenderness
 - ▶ Strong association with polymyalgia rheumatica
 - ▶ Diagnosis: temporal artery biopsy and ESR
 - ▶ **Treatment: steroids; do not wait for biopsy results to start treatment**

You're evaluating a 45 year old woman with a severe headache. As part of

your history-taking, you ask about risk factors. Which of the following is a known risk factor for subarachnoid hemorrhage?

- A) Personal history of type 2 diabetes
- B) Personal history of hyperlipidemia
- C) Family history of alcoholism and substance abuse in first-degree relatives
- D) Sibling with a history of ruptured cerebral aneurysm
- E) African-American ethnicity

Answer: D

Explanation: A first-degree relative with a history of cerebral aneurysm is the only known risk factor listed for subarachnoid hemorrhage. Classic presentation is a sudden-onset headache which is described as the worst headache of a person's life, with associated nausea, vomiting, hypertension, and neck pain. **A low-grade fever does not rule out this condition.**

A CT scan of the head without contrast is done to evaluate this patient and the results are negative. What is the most appropriate next step in diagnosis?

- A) Nothing, the sensitivity of a noncontrast CT scan is high enough to rule out the condition
- B) Order a CT-angiogram of the brain
- C) Order an MRI/MRA of the brain
- D) Perform a lumbar puncture

Answer: D

Explanation: The sensitivity of CT in detecting SAH is almost 100% if performed within the first 6 hours but decreases markedly after 12 hours. **False-negatives can be seen in cases of severe anemia**, amongst others. In the event of a negative CT scan, the most appropriate next step is to perform a lumbar puncture. If the patient has contraindications or refuses, a CT angiogram may be done. This comes with its own complications and should not be used routinely in place of a lumbar puncture. **What are the expected LP findings in a patient with a subarachnoid hemorrhage?**

Look for blood!

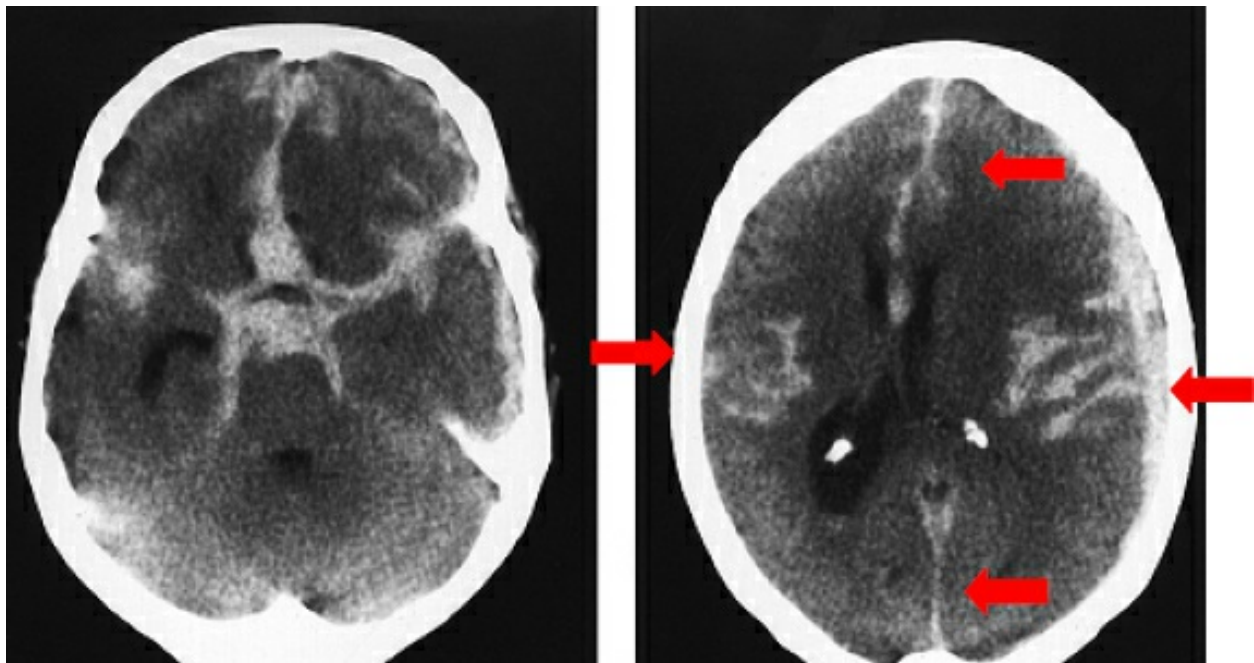
If the RBC count is high, ask to have the test repeated on a tube that was drawn later. For instance, if tube 2 has 500 RBCs, ask the lab to run the same test on tube 4. If the RBC count is zero, the most likely explanation for the presence of RBCs is a traumatic tap. It's important to note that the count must be zero, not just *approaching* zero, in order rule out SAH.

Check for xanthochromia!

It's the most sensitive and specific LP finding for SAH. The CSF will appear yellow due to bilirubin. It takes 2 hours to develop (usually a moot point as it will take at least that long to get a CT scan and gather supplies and consent forms).

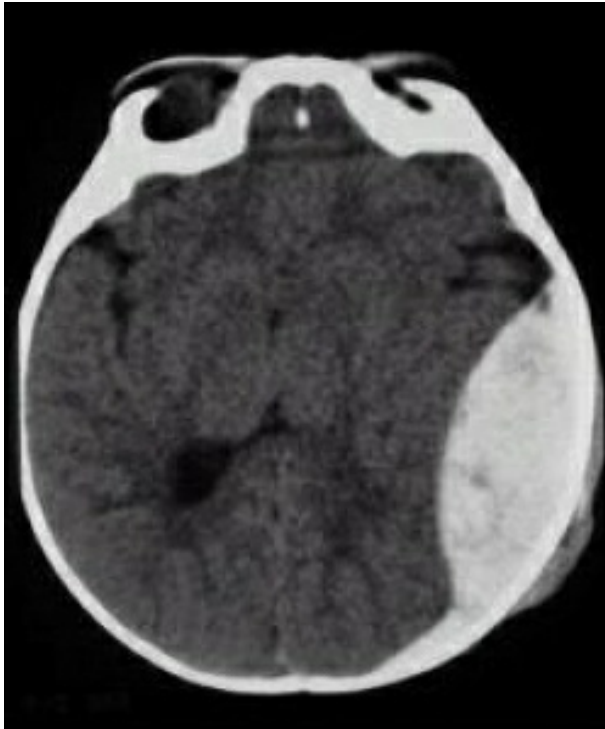
Treatment consists of blood pressure control: target BP is controversial but most sources say systolic should be < 160

Intubating and hyperventilating the patient can be done in some cases: maintain a PCO_2 of 30-35



- Epidural Hematoma
 - ▶ Bleeding from the middle meningeal artery rupture due to fracture
 - ▶ Trauma → brief LOC → lucid interval → headache, AMS

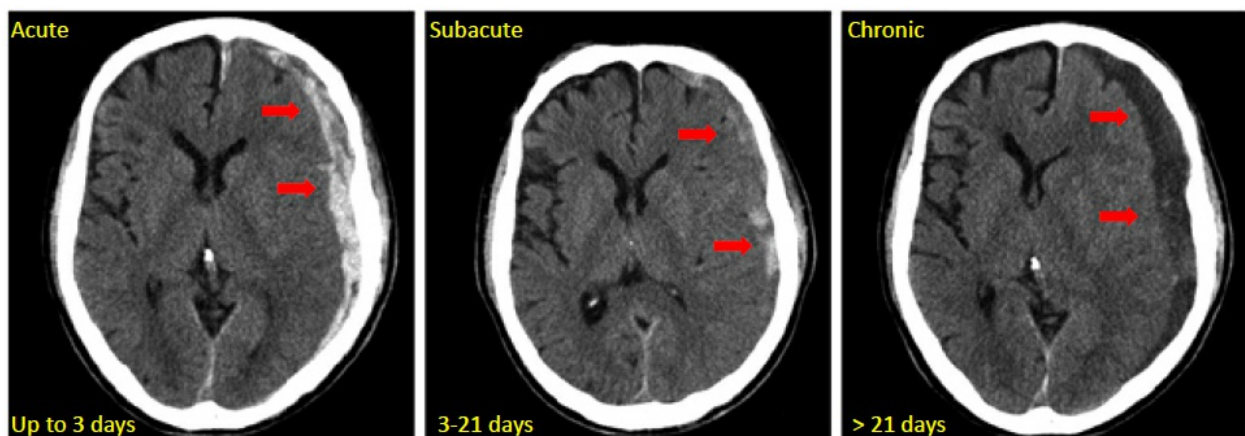
- ▶ Blood is lenticular-shaped on CT



'Lenticular' refers to
'shaped like a lentil'



- Subdural Hematoma
 - ▶ Bleeding from the bridging veins
 - ▶ Symptoms: headache **with or without a lucid interval**
 - ▶ Seen more commonly with trauma, elderly patients, alcoholics
 - ▶ **More common than epidurals and higher mortality rate (!)**
 - ▶ Consider in any dialysis patient with headache or AMS
 - ▶ Blood appears to conform to the shape of the brain on CT scan
 - ▶ May be acute, subacute, or chronic



Now let's talk about NPH...Normal Pressure Hydrocephalus!

How will patients present?

Class triad of dementia, ataxia, and urinary incontinence (wacky, wobbly, wet)

What does the CT show?

Enlarged ventricles (caused by abnormal absorption of CSF by the arachnoid villa)

What does an LP reveal?

Uh...normal pressure?

What other types of 'hydrocephalus' are there?

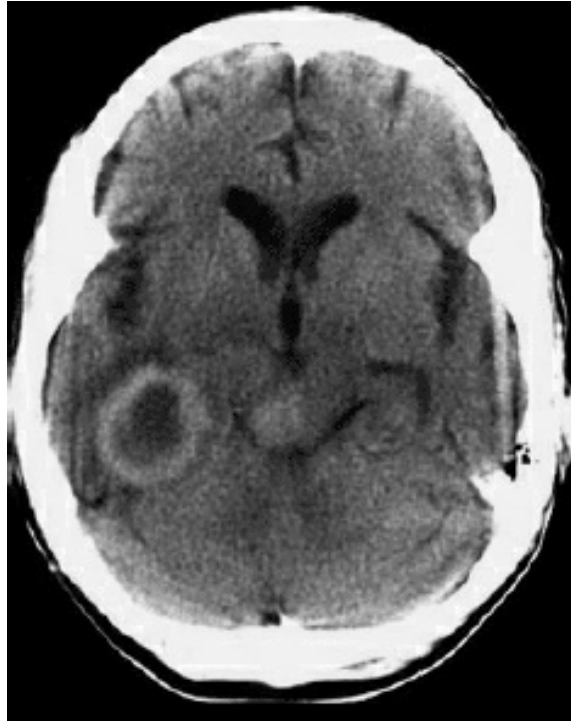
Non-obstructive hydrocephalus aka 'hydrocephalus ex vacuo' is where cerebral atrophy causes passive enlargement of the ventricles

Obstructive hydrocephalus can be due to tumors or shunt blockage - CT will show enlarged ventricles, but avoid doing an LP due to the risk for herniation

Treatment for all types of hydrocephalus is to get rid of excess fluid

- Ventricular Shunt Headache
 - ▶ Evaluate for shunt malfunction and/or infection
 - ▶ Normally, shunt operates with 1-way valves that divert CSF to the bloodstream or a body cavity
 - ▶ Shunt can malfunction due to obstruction, kinking, or disconnection
- Headaches due to brain tumors are classically worse in the morning time
- Pituitary Apoplexy
 - ▶ Impaired blood supply to the pituitary in the setting of a pituitary tumor
 - ▶ Most common initial symptom: sudden-onset headache
 - ▶ Compression of optic chiasm → visual field deficits
 - ▶ Associated with adrenal insufficiency
 - ▶ Treatment: hydrocortisone, surgery

- Toxoplasmosis
 - ▶ Most common CNS mass lesion in AIDS patients
 - ▶ Diagnosis: CT scan *with* contrast shows ring-enhancing lesion



Which of the following is true regarding post-lumbar puncture headaches?

- A) Pain is typically improved by sitting up and worsened by laying flat
- B) Using a lower gauge needle during the LP can decrease the incidence
- C) Bed rest following the procedure can decrease the incidence
- D) Symptoms typically begin within 48 hours

Answer: D

Explanation: Post-lumbar puncture headaches are caused by slow leakage of CSF from the dura. Symptoms typically occur within **12-48 hours** and patients will have headaches that are improved in the supine position. Bed rest following LP has not been shown to decrease the incidence – but using higher gauge needles (smaller needles) and keeping the bevel parallel to longitudinal fibers has. If symptoms are moderate/severe, consider a blood patch. This is the treatment of choice.

MENINGITIS

Bacterial Meningitis

Most common cause?

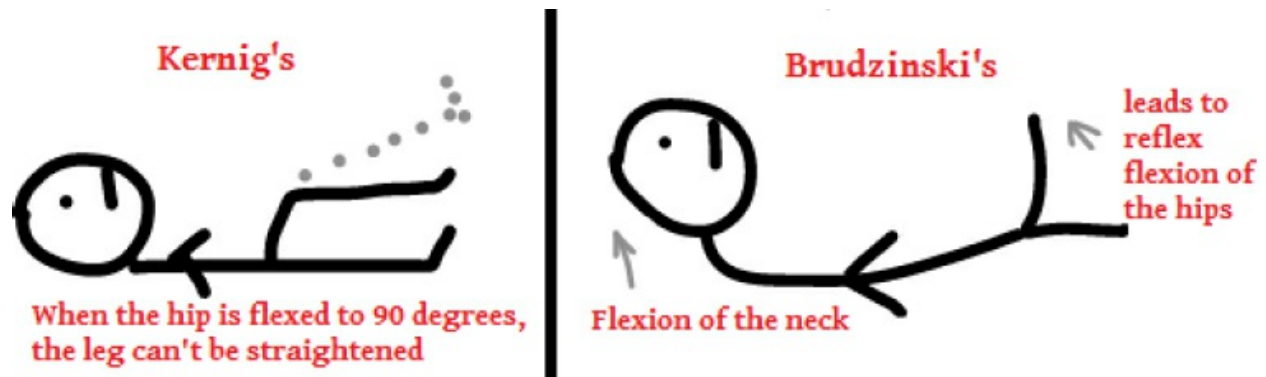
S. aureus is the most common cause in adults

What about other age groups?

According to the CDC:

Newborns	Strep group B, <i>E. coli</i> , <i>Listeria</i>
Infants and Children	<i>S. pneumo</i> , <i>N. meningitidis</i> , <i>H. flu</i>
Adolescents and Young Adults	<i>N. meningitidis</i> , <i>S. pneumo</i>
Older Adults	<i>S. pneumo</i> , <i>N. meningitidis</i> , <i>Listeria</i>

Unique physical exam findings in meningitis:



Treatment of bacterial meningitis:

Empiric treatment of adults is vancomycin + ceftriaxone

In adults > 50 years of age, add ampicillin for *Listeria* coverage

For neonates, use ampicillin + gentamicin

Giving dexamethasone *either 15 minutes before or simultaneously with* antibiotics has been shown to decrease morbidity/mortality – especially in

pneumococcal meningitis (bacterial lysis by antibiotics releases inflammatory mediators)

Do not delay treatment for CT or LP – generally you have two hours from the time antibiotics are started to obtain cultures

Who should get a CT scan before LP?

High risk groups include adults with focal neurologic deficits, age > 60, history of CNS disease/altered mental status, and immunosuppressed patients

What do we need to know about N. meningitidis?

It's the most common cause of meningitis in adolescents and young adults
Waterhouse-Friderichsen syndrome: meningococcemia leading to bilateral adrenal hemorrhage/failure → hypotension, sepsis, DIC, death



How about close contacts / post-exposure prophylaxis?

Administer a single oral dose of ciprofloxacin, two days of rifampin, or a single IM dose of ceftriaxone

**** For anyone with fever + stroke-like symptoms consider encephalitis.
MRI + LP will be diagnostic and empiric IV acyclovir can be started while results are pending ****

Regarding CSF analysis, which of the following findings is most abnormal?

- A) > 1 PMN
- B) Opening pressure 15 mmHg
- C) CSF : serum glucose ratio of 0.6

D) > 10 RBCs

Answer: A

Explanation: Normal CSF contains at most 1 PMN and no more than 5 WBC. An opening pressure between 10-20 is considered normal, and red blood cells may be seen following a traumatic tap. Cryptococcal meningitis is classically associated with very high opening pressures – in fact opening pressures can be trended (by repeat LPs) to gauge response to treatment. Treatment is amphotericin B + flucytosine.

MENINGITIS	Bacterial	Viral	Fungal/TB
Opening pressure	High	Normal to high	Very high for fungal
Protein	High	Low	Slightly high
Glucose	Low	Normal	Slightly low
Predominant cell	PMN	Lymphocytes	Lymphocytes
Gram stain	Positive	No organisms	

NEUROMUSCULAR DISORDERS

- Multiple Sclerosis
 - ▶ Patients present with multiple neurologic deficits separated by time
 - ▶ Pathology: demyelination of multifocal areas of CNS leading to slowed nerve conduction
 - ▶ Pathognomonic: **bilateral internuclear ophthalmoplegia** (when looking right, the left eye won't adduct; looking left, the right eye won't adduct)
 - ▶ CN VI (abducens) is the most commonly affected cranial nerve (causes diplopia) when only one CN is affected; CN II (optic) is the overall most commonly affected

- ▶ Patients with acute exacerbations become less responsive to steroids over time
- ▶ Treatment for an 'MS flare' is high-dose steroids, often methylprednisolone 1gram IV per day for three days

Optic neuritis might be the presenting symptom for patients with MS. If someone comes in saying they have pain in their eye, vision loss, and can't see the color red, they might as well be saying 'I think I have optic neuritis'. Patients with MS who present with optic neuritis as their first manifestation actually have a more benign long-term course. Treatment for optic neuritis is IV steroids! MS is one of the rare times that IV steroids are actually more beneficial than oral steroids.

- Guillain-Barre Syndrome
 - ▶ Autoimmune demyelinating disease
 - ▶ Acute **ascending paralysis**
 - ▶ Can be preceded by a URI syndrome (influenza, campylobacter)
 - ▶ **Hallmark finding: loss of DTRs**
 - ▶ CSF will show albuminocytologic dissociation (increased protein)
 - ▶ Can lead to respiratory failure and eventual death
 - ◆ Indications for intubation in GBS patients:
 - ★ Vital capacity < 15mL/kg
 - ★ PaO₂ < 70
 - ★ Aspiration
 - ★ Difficulty with breathing, swallowing, or speech
 - ▶ Treatment: supportive care and IVIG (*not steroids*)
 - ▶ Miller-Fisher is a variant of Guillain-Barre with descending paralysis (ophthalmoplegia with ataxia and areflexia)
- Hypokalemic Periodic Paralysis is a rare autosomal dominant disorder that typically begins in adolescence. During an acute attack, there is pure muscle weakness with normal sensation (reflexes may be diminished or absent). Attacks are precipitated by heavy exercise, fasting, or high carb meals, and symptoms range from mild weakness to full body paralysis. Distinguish this from 'Thyrotoxic Periodic Paralysis' which is paralysis brought on by hyperthyroidism.

- Botulism
 - ▶ Clostridium botulin toxin prevents acetylcholine release
 - ▶ Patients are alert with **early ocular involvement (ptosis, fixed and dilated pupils, diplopia, blurred vision and photophobia)**, symmetric descending motor paralysis with arms weaker than legs
 - ▶ To distinguish this from myasthenia: **lack of pupillary light reflex** and loss of DTRs
 - ▶ Death most often occurs from respiratory failure
- Myasthenia Gravis

What is it? An autoimmune disease directed against acetylcholine receptors

How do patients present? PTOSIS (most commonly), muscle weakness, and true muscle fatigue (that worsens with repetitive use)

Two bedside diagnostic tests (note that both require ptosis to be present):

- 1 – tensilon test: inject edrophonium and look for improvement in ptosis; this can induce bradycardia so have atropine ready!
- 2 – ice pack test: place an ice pack over the patient's eyes for two minutes and look for improvement in ptosis

What's the worst that can happen? Myasthenia crisis!

Crisis refers to severe cases where weakness results in respiratory failure or the inability to swallow. Check a forced vital capacity (FVC) or negative inspiratory force (NIF) : **NIF < 20 is an indication for intubation**. ABGs are poor indicators of impending respiratory failure.

Treatment: Once the airway is stabilized, first-line treatment includes steroids, IVIG, and plasmapheresis. But here's what you *need* to know: anticholinesterase drugs like pyridostigmine have a rapid onset of action. Dosing can be tricky as it varies for every patient: the key is to get the benefits while limiting cholinergic side effects. Too much pyridostigmine can cause 'cholinergic crisis' which is difficult to distinguish from 'myasthenia crisis'. Both cause severe weakness and difficulty breathing. The differences lie in the pupils (miosis vs mydriasis) and in

salivation/lacrimation (increase vs decrease).

Workup: Do a thorough search for infection which can precipitate an exacerbation. Be very careful when selecting antibiotics as some classes may cause more harm.

Going back to the issue of myasthenic crisis and intubation, which of the following medications should be avoided?

1 – Etomidate 2 – Succinylcholine 3 – Versed 4 – Propofol

The answer: Succinylcholine. Since MG destroys acetylcholine receptors, depolarizing and nondepolarizing agents should be used with caution. Higher doses of succinylcholine than normal would be required so paralysis may be prolonged.

- Lambert-Eaton Syndrome
 - ▶ Clinically similar to myasthenia gravis
 - ▶ Autoimmune disease with failure of release of acetylcholine from terminal axons of motor neurons
 - ▶ Associated with small cell lung cancer
 - ▶ Symptoms: weakness of proximal muscles (thighs, hips) that improves with repetitive use, dry mouth, erectile dysfunction - ptosis and diplopia occur much less frequently
 - ▶ Treatment: IVIG, plasmapheresis
- Tick Paralysis
 - ▶ Rapid ascending paralysis and ataxia that is reversible if the tick is removed
 - ▶ DTRs are almost always lost
 - ▶ Treatment: find and remove the tick

	Guillain-Barre	Botulism	Myasthenia Gravis	Lambert-Eaton	Tick
Paralysis	Ascending	Descending	Prox > Distal	Prox > Distal	Ascending
DTR	Lost	Lost	Maintained	Maintained	Lost
IVIG	Yes	No (antitoxin)	Yes	Yes	
Plasmapheresis	Yes	No	Yes	Yes	
Steroids	No	No	Yes	Yes	

Which of the following is not typically found in patients with Wernicke's encephalopathy?

- A) Ataxia
- B) Ophthalmoplegia
- C) Tremor
- D) Altered mental status
- E) Nystagmus

Answer: C

Explanation: Wernicke's is due to a thiamine deficiency (vitamin B1), and is seen in chronic alcoholics and the malnourished. The classic triad is encephalopathy, nystagmus (ophthalmoplegia), and ataxia. Treatment is thiamine replacement.

SEIZURES

A patient with a past medical history significant only for tuberculosis presents with a first-time seizure. Is there any connection?

Remember the side effects of INH: **I**njures **N**eurons and **H**epatocytes
In any seizing patient on INH, consider giving vitamin B6 to stop the convulsions

- Todd's paralysis = focal transient weakness following a seizure; significant because it makes it difficult to differentiate from an acute stroke. This is why 'seizure' is a relative contraindication to thrombolytics.
- Simple partial (focal) motor seizures: no LOC
- Complex partial (temporal lobe) seizures: may lose consciousness
- **Status Epilepticus**
 - ▶ By definition, it is continuous seizure activity >20 mins or back-to-back seizures with no inter-ictal period
 - ▶ Most common trigger: subtherapeutic drug levels
 - ▶ Patients may continue to have EEG-detected electrical discharge even after tonic-clonic movements have ended; if the patient is paralyzed for intubation, you MUST monitor EEG activity to ensure they are not seizing

*Here's how the question may appear: a patient suffers a tonic-clonic seizure and now has continued gaze deviation and facial twitching. What is the diagnosis? The answer: any continuing convulsions or jaw/eyelid twitching, no matter how minor, should be considered ongoing seizure activity. This patient has **non-convulsive status epilepticus**.*

Nasal airway, facemask oxygen
Check glucose

Benzo #1
(Ativan 0.1mg/kg IV)

Benzo #2
(Ativan 0.1mg/kg IV)

Propofol
1.5mg/kg IV

Rapid sequence
intubation

Phenytoin load (20mg/kg IV)

Search for reversible causes

First  EM

Workup and Management of Status Epilepticus

How should airway/breathing be handled?

You don't need to ventilate the patient immediately, but oxygen is important because the patient is burning through it very quickly. Apply a non-rebreather facemask in an attempt to provide some apneic oxygenation. Placement of a definitive airway (oral intubation) can wait. The first priority is terminating seizure activity. Don't forget to check a blood sugar!

Start a benzodiazepine

It really doesn't matter which one you pick – they all work. Usually this first dose will have already been given before the patient arrives. If an IV has not been started, use either an IM or intranasal dose before placing an IO.

Special Case: Eclampsia

Eclampsia must be considered in any female of childbearing age. Remember that it can occur up to 6 weeks postpartum, so you may need to treat empirically with magnesium 4-6 grams IV.

Phenytoin

Most published algorithms will have with phenytoin or fosphenytoin as the second-line agent. These meds take at least 20 minutes to work and phenytoin is generally contraindicated for toxicologic seizures. If a patient doesn't respond to a few good doses of a benzo, prep for intubation. Order the phenytoin but prep for intubation. Propofol is a great induction agent and has anti-epileptic properties. If there are contraindications, primarily any concern about cardiac reserve or hemodynamic stability, ketamine 2 mg/kg IV is a good alternative.

Choice of paralytic

Succinylcholine can cause hyperkalemia if seizures have been extremely prolonged or if there is an underlying neurologic disorder. However, the prolonged paralysis of rocuronium increases the risk of developing nonconvulsive status epilepticus. In an ideal situation, after intubation the patient can be hooked up to continuous EEG monitoring and nonconvulsive status epilepticus is easily diagnosed, but this isn't always the case. In

general, use succinylcholine.

Search for reversible causes:

Infectious - consider empiric antibiotics and acyclovir

Eclampsia

Isoniazid toxicity - the antidote is pyridoxine

Hyponatremia - NaCl 3% 2ml/kg; may repeat in ten minutes if needed

Alcohol withdrawal - you are already treating this, but will need a lot more benzos

Cyanide - hydroxocobalamin or the cyanide antidote kit (amyl nitrate, sodium nitrite, and sodium thiosulfate)

- Febrile Seizures
 - ▶ Usually occur between 6 months and 6 years of age
 - ▶ *Simple* last < 15 minutes with no focal features
 - ▶ *Complex* last > 15 minutes and have focal features
 - ▶ Indications for LP
 - ◆ Meningeal signs present
 - ◆ Less than 12 months of age with no HiB or S. pneumo immunization
 - ◆ Febrile status epilepticus
 - ▶ Children are at risk for recurrent febrile seizure and *are at higher risk of epilepsy than the general population*
 - ▶ Risk factors for recurrence
 - ◆ Age < 12 months
 - ◆ Lower temperature at the time of seizure
 - ◆ Shorter duration of fever before seizure
 - ◆ + family history of febrile seizures
 - ◆ Complex febrile seizure
 - ▶ Antiepileptics are not indicated after a febrile seizure

What are vagal nerve stimulators (VNS)?

Implantable devices use to prevent seizures by providing intermittent stimulation of the left vagus nerve. Placing a magnet over one can deliver extra stimulation and should be done if the patient feels a seizure coming on.

In a slightly related topic, be aware of a syndrome known as ‘neurogenic pulmonary edema’ – if a postictal patient is hypoxic and has rales on exam, consider this entity and treat as you would for any other case of pulmonary edema.

SPINE

Upper Motor Neuron Lesion

Normal muscle mass
Hyperreflexia
Spasticity and clonus

Lower Motor Neuron Lesion

Muscle atrophy
Hyporeflexia
Fasciculations

What is the Babinski reflex? Normal up to the age of 2 but in anyone older than that it is pathologic and a sign of upper motor neuron lesion (spinal cord disease). The big toe extends up and back while the other toes fan out.

- Cauda Equina Syndrome
 - ▶ Compression of peripheral nerve roots S2-S5
 - ▶ Etiology: metastatic disease, trauma, disk herniation, epidural abscess
 - ▶ LMN lesion
 - ▶ Urinary retention and overflow incontinence is the most sensitive sign
 - ▶ Symptoms: lower extremity weakness, hyporeflexia, saddle anesthesia, fecal incontinence, loss of anal tone
 - ▶ Treatment: stat neurosurgery consultation for decompression
- Epidural Abscess
 - ▶ Classic triad: fever, back pain, neurologic deficits (present in only 15% of patients). **Fever is only present in 50% of cases!**

- ▶ Most common organism: *S. aureus*
- ▶ Risk factors: epidural catheters, diabetes, alcoholism, HIV infection, bacteremia, and IV drug abuse
- ▶ If clinical suspicion is low after history and physical exam, a low ESR and CRP support not ordering an MRI. If suspicion is high, an MRI should be ordered regardless of ESR and CRP levels
- ▶ CT scan has almost no role in evaluation; the entire spine should be imaged by MRI
- ▶ Treatment: emergent IR-guided drainage, antibiotics (should be started without delay, ie before MRI is performed)



- Potts Disease
 - ▶ Extra-pulmonary TB affecting the spine
 - ▶ Most often seen in lower thoracic and upper lumbar vertebrae
 - ▶ Symptoms: back pain, fever, night sweats, anorexia

You know what would make a really great boards question:
What is the most common site of extra-pulmonary TB?

The answer: cervical lymph nodes

*** Always consider malignancy as a cause of chronic back pain, especially in elderly patients ***

- Amyotrophic Lateral Sclerosis (ALS)
 - ▶ Combined upper and lower motor neuron disease
 - ▶ The first sign of ALS is weakness in one hand, one leg, the face, or the tongue. The weakness spreads to both arms and both legs. Over time, patients get muscle atrophy, fasciculations, difficulty eating/swallowing. ALS is progressive and lethal and causes death by respiratory failure.
 - ▶ Characteristically, **there is no loss of sensation**
- Syringomyelia
 - ▶ Expanding central cavity in spinal cord, usually in cervical/thoracic area
 - ▶ Can be post-infectious, post-inflammatory (MS), or post-traumatic - but most often associated with Arnold-Chiari malformations
 - ▶ Symptoms: chronic and progressive **loss of pain/temperature in hands**, intraosseous muscle wasting, loss of bowel/bladder control
 - ▶ Diagnosis: MRI
 - ▶ Treatment: pain control, some patients may require surgery

STROKE

- **Transient Ischemic Attack (TIA)**
 - ▶ Transient neurologic dysfunction caused by ischemia without infarction
 - ▶ Presents similar to stroke but, by definition, duration of symptoms is less than one hour
 - ▶ Most common cause: embolus from a dislodged atherosclerotic

- plaque
- ▶ TIA is considered a warning that a thrombotic stroke is coming. The greatest risk for stroke after a TIA is in the first two days!
- ▶ Treatment: antiplatelet agents (aspirin to start with)

Ischemic Stroke

Blood pressure should only be reduced in tPA candidates or if systolic > 220mmHg

Thrombolytics should be given within 4.5 hours of onset of symptoms. If a patient woke up with stroke-like symptoms, then use the last time they felt symptom-free as your time of onset. Patients who develop a headache, decreased LOC, nausea/vomiting, or sudden rise in blood pressure after receiving tPA should be suspected of having an intracranial bleed. Stop the infusion, get a stat CT head, send off labs, and administer 10 units of cryoprecipitate and 6 units of platelets.

Contraindications for tPA:

- ▶ Symptom onset >4.5 hours, unknown, or patient awoke with stroke
- ▶ Acute or previous intracranial hemorrhage
- ▶ Head trauma, intracranial surgery, or previous stroke within 3 months
- ▶ GI malignancy or GI bleed within 21 days
- ▶ Active internal bleeding
- ▶ Persistent elevated blood pressure (> 185/110)

Plavix (clopidogrel) is an anti-platelet agent and therefore not a contraindication to use of tPA. The NOAC (novel anticoagulants), or DOAC (direct anticoagulants) as they are sometimes called, include xarelto, pradaxa, and eliquis among others. The main issue is time of last dose as to whether or not the patient is eligible for tPA. The AHA recommends tPA in patients on warfarin if the INR is 1.7.

An anterior cerebral artery stroke causes weakness in legs > arms or face. A middle cerebral artery stroke causes weakness in the arms and face > legs.

Strokes involving the left MCA are also associated with aphasia

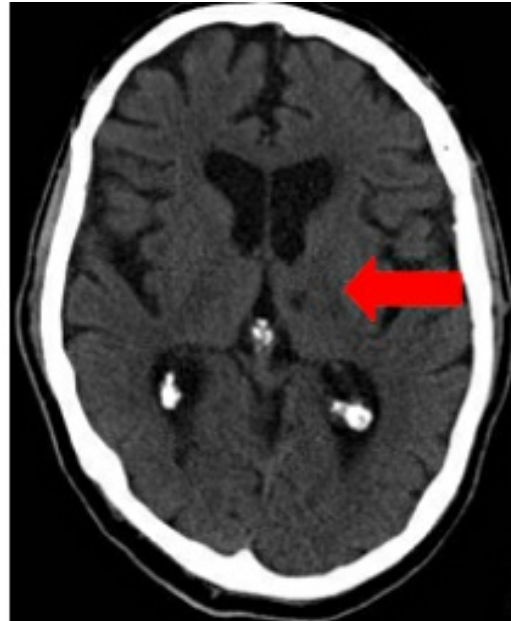
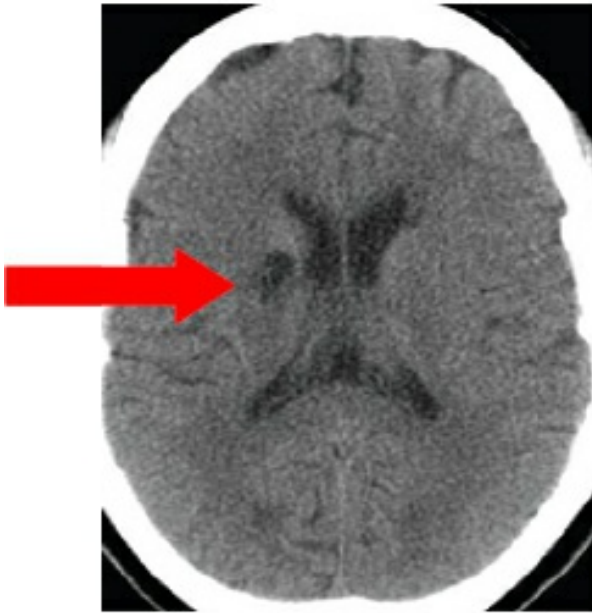
Strokes involving the right MCA are associated with hemineglect

A *posterior cerebral artery* stroke causes vision loss (homonymous hemianopsia) A **vertebrobasilar artery** stroke is the one you should probably know about: this artery supplies the brainstem and cerebellum so will often be missed on CT scan (necessitating use of MRI). **Crossed deficits are classic** (ipsilateral CN palsy with contralateral hemiplegia) + vertigo, nystagmus, or ataxia

- ▶ “Locked-in syndrome”
 - ◆ Basilar artery infarction
 - ◆ Patients are awake and cognitively aware, eye movements are spared, but they are quadriplegic and can’t speak or swallow
- ▶ Wallenberg’s syndrome
 - ◆ Refers to a stroke affecting the lateral part of the medulla oblongata; most often due to a blockage in the PICA or vertebral artery
 - ◆ Patients typically have ipsilateral cranial nerve deficits and contralateral pain/temperature loss in the trunk or extremities
 - ◆ Ataxia, nystagmus, vertigo, or Horner’s syndrome may be seen

Cortical strokes account for 75% of ischemic strokes and are those that involve the ACA, MCA, or PCA. Lacunar strokes, on the other hand, involve occlusion of branches of those larger cerebral arteries that penetrate into the deep structures of the brain such as the basal ganglia, thalamus, and internal capsule. Cortical strokes involve relatively large areas of brain tissue, whereas lacunar strokes affect only that tiny area supplied by a small end-vessel. But they can affect areas that have thousands of motor and sensory fibers bundled together and may look just as debilitating as a cortical stroke. Presentation can vary widely. Lacunar strokes are associated with diabetes, HTN, and smoking.

- ▶ Different types include:
 - ◆ Pure motor – pons, internal capsule
 - ◆ Pure sensory – thalamus
 - ◆ Dysarthria/hemiparesis
 - ◆ Ataxia/hemiparesis



Hemorrhagic Stroke

Target systolic blood pressure: 140mmHg

The 'Cushing Reflex' (HTN and bradycardia) is a late sign of increased ICP and indicates impending herniation in patients with hemorrhagic stroke. Speaking of herniation, an ipsilateral fixed dilated pupil with contralateral hemiparesis is a sign of uncal herniation.

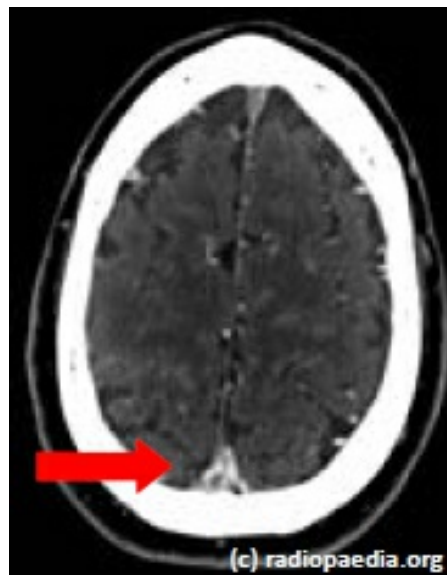
A 32 year old woman presents with gradual onset headache. After four days of suffering, she has a seizure for the first time. Her husband brings her to the ER where a CT scan shows intracerebral hemorrhage. CT angiogram and venograms are performed and the patient is diagnosed with cerebral venous thrombosis with an intracerebral hemorrhage. Which of the following is the most appropriate next step?

- A) Start low-molecular weight heparin
- B) Administer a single dose of aspirin 325mg
- C) Reverse any pre-existing coagulopathy
- D) Perform a lumbar puncture

Answer: A

Explanation: Cerebral venous thrombosis is rare. Patients typically present with gradual onset headache that progresses to seizures, focal neurologic deficits, and depressed levels of consciousness. Patients may have subarachnoid hemorrhage at the time of diagnosis (in other words, this can present with a *thunderclap headache*). Anticoagulation is the most commonly accepted treatment even in cases of ICH-related CVT. Of note, there is a much higher incidence in pregnant women.

Cavernous sinus thrombosis is a type of cerebral vein thrombosis: it is caused by spread of infection from the nasal or paranasal sinuses. *S. aureus* is most commonly isolated. Symptoms include periorbital edema, proptosis, and photophobia as well as CN III-VI deficits.



The ‘Empty Delta sign’ is a CT finding seen in dural venous sinus thrombosis of the superior sagittal sinus. Dural venous thrombosis is another type of cerebral vein thrombosis. This sign is only found on contrast-enhanced CT or MRI (typically a venogram).

- **Bells Palsy**

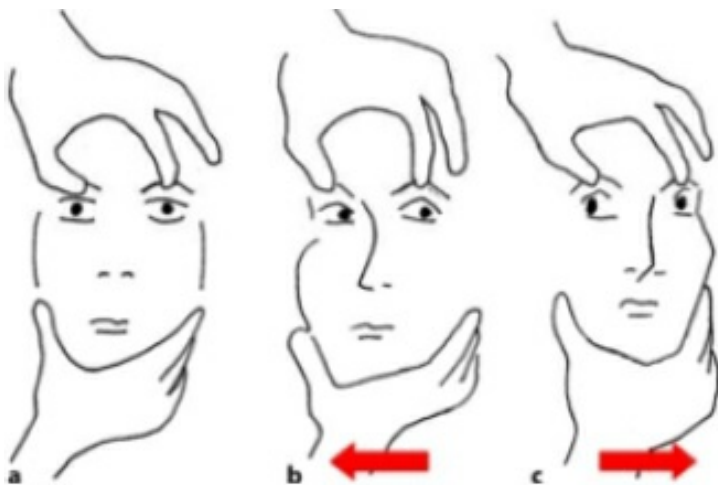


- ▶ Peripheral facial nerve (CN VII) palsy
- ▶ Patients present with **facial droop that also involves the forehead**
- ▶ Other symptoms: hyperacusis, decreased tear production
- ▶ Most cases are idiopathic with no known cause
- ▶ Treatment: steroids (start within 72 hours; the earlier the better)
- ▶ Consider antivirals (acyclovir) but only if symptoms are severe
- ▶ Ramsay-Hunt syndrome
 - ◆ Ipsilateral facial paralysis, **ear pain, and vesicles in the auditory canal** Generally more severe than a typical case of Bells palsy

ALTERED MENTAL STATUS

- An easy mnemonic that summarizes the differential diagnosis: AEIOU TIPS
 - ▶ Alcohol
 - ▶ Endocrine, electrolytes, encephalopathy
 - ▶ Infection
 - ▶ Overdose
 - ▶ Uremia
 - ▶ Trauma, temperature
 - ▶ Insulin

- ▶ **Poisoning, psychosis**
- ▶ **Stroke, seizures**
- **Brainstem Reflexes**
 - ▶ **Cold calorics (oculovestibular reflex)**
 - ◆ Position comatose patient supine and irrigate ear with ice cold water
 - ◆ If brainstem and cortex are intact: nystagmus with fast component to opposite ear
 - ◆ If brainstem injured, no eye deviation
 - ◆ If cortex injured but brainstem intact, eyes deviate toward cold ear
 - ▶ **Doll's eyes (oculocephalic reflex)**
 - ◆ Done only in comatose patients with no concern for C-spine injury
 - ◆ If brainstem intact, eyes move in opposite direction of head
 - ◆ If brainstem injured, eyes stay fixed





**OBSTETRICS /
GYNECOLOGY**

SEXUALLY TRANSMITTED DISEASES

Many have already been covered in the “Nephrology/Genitourinary” chapter and will not be presented here again...

Which of the following is not a risk factor for pelvic inflammatory disease (PID)?

- A) Multiple sexual partners
- B) Advanced age
- C) Delivery by an untrained person
- D) Smoking
- E) Use of an IUD

Answer: B

Explanation: The biggest risk factor for PID is untreated chlamydia or gonorrhea. It is more common in the young (adolescence is a risk factor) and in those with multiple sexual partners, those who use IUDs, and smokers. Delivery itself is not a risk factor but delivery by an untrained person is. The peak time of onset is within one week of menses.

What symptoms do PID'ers have?

Uterine and cervical motion tenderness, vaginal discharge, and fever

Can PID cause any long-term problems?

Patients are now at higher risk for ectopic pregnancy and infertility

Wow! Anything else?

Perihepatitis (Fitz-hugh-curtis Syndrome) can occur as a result. The liver capsule becomes inflamed leading to adhesions. Liver function tests will be *normal*.

How can I treat this?

Cefotetan or cefoxitin + doxycycline

Clindamycin + gentamicin

Ceftriaxone + doxycycline +/- metronidazole

When should I admit?

If patients are pregnant, have intractable pain/vomiting, have failed outpatient therapy, or have tubo-ovarian abscesses (TOA)

Tubo-ovarian whats-es?

Most TOAs are polymicrobial and treatment involves ampicillin + clindamycin + gentamicin. If they are greater than 10 cm they may require surgical drainage.

- Genital Herpes
 - ▶ Most common cause of genital ulcers in the US; HSV-2 was responsible for 90% of new cases previously, now closer to 50%
 - ▶ Once infected, the virus remains dormant and can reactivate. Primary infections are typically the worst and the rash can last two weeks; secondary infections usually last 6-12 days. Asymptomatic/**subclinical viral shedding can occur** even after the primary infection resolves.
 - ▶ Diagnosis: One option is to unroof a vesicle with a scalpel and send a viral culture. A better option is to order HSV PCR.
 - ▶ Pregnant women with active genital herpes require C-section

Your next patient says she was sharing a tractor with her boyfriend and now has a smelly green discharge and her cervix look like a strawberry. Her boyfriend says it's because she forgot to clean the seat before sitting down.

Break the bad news: she has trichomonas which is spread entirely by sexual intercourse. It can be asymptomatic 70% of the time (more so in males) but she needs a one-time dose of metronidazole 2 grams.

- **Condyloma Accuminata**
 - ▶ Anogenital warts
 - ▶ **Most common viral sexually transmitted disease in the US (HPV)**

- ▶ Risk factor: increased number of sexual partners
- ▶ Increases risk for anogenital cancers
- ▶ Treatment: imiquimod, cryotherapy

GYNECOLOGY

Bacterial Vaginosis is the most common cause of vaginal discharge. The discharge is mostly white colored with **clue cells** (epithelial cells coated with bacteria).

BV is an overgrowth of normal vaginal flora and not considered a true STD. Treatment is topical azoles or oral metronidazole for seven days.

Know the differences in pH:

BV vaginal pH is > 4.5

Trichomoniasis vaginal pH is > 4.5

Candida albicans vaginal pH is normal (3.8-4.5)

Symptoms of candida are itching, dyspareunia, and cottage cheese discharge. Treatment is oral fluconazole or topical azoles.

- Bartholin Cyst/Abscess
 - ▶ Typically a *polymicrobial* infection
 - ▶ Treatment: incision/drainage, word catheter placement
 - ▶ Antibiotics are usually unnecessary



- Ovarian Cyst
 - ▶ Most are benign
 - ▶ Occurs in all age groups but most common during childbearing years
 - ▶ Diagnosis: ultrasound
 - ▶ Ruptured cysts are mostly treated conservatively

If your patient has a large ovarian cyst and has sudden onset adnexal pain: remember that a large cyst is a large risk factor for a large ovarian torsion. Diagnosis is made by a large ultrasound.

A normal doppler ultrasound does not rule out torsion! If suspicion remains, consult an OB/Gyn

- Dysfunctional Uterine Bleeding (DUB)
 - ▶ Heavy vaginal bleeding in the absence of structural or organic disease
 - ▶ Most often the result of anovulation
 - ▶ Treatment
 - ◆ Mild: Iron supplements
 - ◆ Moderate and no active bleeding: progestin + iron supplements
 - ▶ ◆ Moderate with active bleeding: high dose estrogen Women over the age of 35 need an endometrial biopsy
- Mittelschmerz
 - ▶ Mid-cycle pain typically seen 2 weeks after the start of the LMP

- ▶ Common in women with regular periods who are not taking birth control
- ▶ Pain is the result of ovulation itself and can lateralize to one ovary
- Primary Dysmenorrhea
 - ▶ Cramping pain in the lower abdomen occurring just before or during menstruation in the absence of other pathology (such as endometriosis)
 - ▶ Typically starts in adolescence and the physical exam is normal
 - ▶ Most cases respond to NSAIDs
- Emergency contraception
 - ▶ Levonorgestrel ('Plan B') works for up to four days after intercourse
 - ▶ Ulipristal ('ella') works for up to five days and may be more effective. It requires a prescription, while Plan B is over the counter.
- Endometriosis
 - ▶ Endometrial glands at extrauterine sites (ovary is most common)
 - ▶ Associated with chronic pelvic pain and infertility
 - ▶ **Diagnosis is by direct visualization** (laparoscopy)
- Leiomyomas (Fibroids)
 - ▶ Most common pelvic tumor in women
 - ▶ Contain estrogen-sensitive receptors so they often enlarge rapidly during pregnancy but tend to regress during menopause
 - ▶ Symptoms: pelvic pain, abnormal vaginal bleeding
 - ▶ Treatment: hormones may help; definitive treatment is hysterectomy



Here's something you're probably not going to see in the ER but may see on an exam: **ovarian hyperstimulation syndrome**. This is a condition that may affect the ovaries of women taking fertility drugs. Most cases are mild but in severe forms there may be abdominal distension, ascites, oliguria, pleural effusion, or respiratory distress. Hemoconcentration (**elevated hematocrit**), and **elevated transaminases** or **coagulopathy** (from reduced liver perfusion) may be seen. In fact, *an elevated hematocrit is the most important measure in deciding if a patient should be hospitalized*. If the patient's hematocrit is greater than 60% and if she has ascites, immediate hospitalization is indicated. Symptoms of ovarian hyperstimulation syndrome generally resolve in 1-2 weeks and treatment is mostly supportive.

A quick review of three GYN cancers you should know about:

Any postmenopausal woman with vaginal bleeding needs five letters to make a diagnosis: EMB/US.

Endometrial biopsy (EMB) and ultrasound (US) to rule out endometrial cancer. Risk factors are diabetes, obesity, nulliparity, early menses, and late menopause.

If an older female has malignant pleural effusion or ascites, consider ruling out ovarian cancer – risk factors include family history, infertility, low parity, and high fat diet.

Early pap smears and screening is needed in women with multiple sex partners and with history of STDs to evaluate for cervical cancer. Symptoms include postmenopausal bleeding, postcoital bleeding, and really any abnormal bleeding.

OBSTETRICS

- Physiologic changes in pregnancy
 - ▶ Increased heart rate, cardiac output, WBC, and tidal volume (no change in respiratory rate so patients may have a subjective dyspnea)
 - ▶ Decreased 2nd trimester blood pressure, BUN/creatinine, and delayed GI motility/gastric emptying
- Hyperemesis Gravidarum
 - ▶ No strict diagnostic criteria but generally defined as intractable nausea and vomiting with some degree of weight loss
 - ▶ #1 reason for hospital admissions in the 1st trimester
 - ▶ Symptoms peak at 9-10 weeks and generally resolve by 16-18 weeks
 - ▶ ‘Diclegis’ is a new medication containing vitamin B6 + doxylamine; zofran use in first trimester has recently been questioned due to a possible link with congenital heart defects
- Human Chorionic Gonadotropin (hCG)
 - ▶ Can be detected 6-12 days after ovulation
 - ▶ Doubles every 2-3 days for the first 10 weeks
 - ▶ Declines every 2-3 days for the next 10 weeks

- ▶ Detectable for up to 2-3 weeks post delivery
- ▶ Twin pregnancies, on average, have higher hCG levels than singleton ones, but still fall within the normal range for singleton pregnancies
- Earliest ultrasound finding of pregnancy: presence of a gestational sac seen at 4-5 weeks by transvaginal approach, 6 weeks by transabdominal
 - ▶ First true embryonic structure is yolk sac (seen at 5 weeks)
- **Miscarriage**
 - ▶ Threatened
 - ◆ Vaginal bleeding, abdominal pain, or both
 - ◆ Cervical os closed
 - ▶ Inevitable
 - ◆ Bleeding and pain/cramping more intense
 - ◆ Cervical os dilated
 - ▶ Incomplete
 - ◆ Bleeding and pain/cramping more intense
 - ◆ Some products of conception being passed
 - ◆ Cervical os open
 - ▶ Complete
 - ◆ Cervical os usually closed
 - ◆ Ultrasound shows empty uterus
 - ▶ Septic
 - ◆ Polymicrobial infection when bacteria enters the uterus
 - ◆ Fever, abdominal pain, vaginal bleeding + discharge, sepsis
 - ◆ Treatment: IV antibiotics, D&C

A 30 year old woman presents with left sided abdominal pain and vaginal bleeding. You suspect a diagnosis of ectopic pregnancy – which of the following is true?

- A) 90% of women who have ectopic pregnancies have at least one risk factor
- B) Visualizing an intrauterine pregnancy on ultrasound rules out an ectopic
- C) The number one risk factor for ectopic pregnancy is a history of PID
- D) None of the above are true

E) All of the above are true

Answer: D

Explanation: Approximately 50% of women with ectopic pregnancies have no risk factors. The number one risk factor is a previous history of ectopic pregnancy. Be mindful of heterotopic pregnancies (especially in women on fertility treatment); visualizing an IUP does not rule out a concomitant ectopic pregnancy.

All of the following are true regarding diagnosis of ectopic pregnancy except:

- A) Serial measurements of hCG can help distinguish an IUP from an ectopic
- B) If the hCG level is decreasing, it should continue to be monitored until it has reached zero, no matter how long this takes
- C) Almost 50% of women can have increasing hCG levels and still have an ectopic pregnancy
- D) The most common location for an ectopic pregnancy is the fallopian tube
- E) All of the above are true

Answer: E

Which of the following is true regarding treatment of an ectopic pregnancy?

- A) Surgical management improves future potential for fertility compared to medical management alone
- B) The preferred surgical treatment is laparotomy
- C) The ideal patient for non-surgical management has an hCG < 5000 and an ectopic size < 4 cm
- D) The most common side effect of methotrexate is separation pain – if patients are given methotrexate and return to the ER with abdominal pain, a repeat ultrasound is not necessary
- E) An ectopic pregnancy will not heal without either medication or surgery

Answer: C

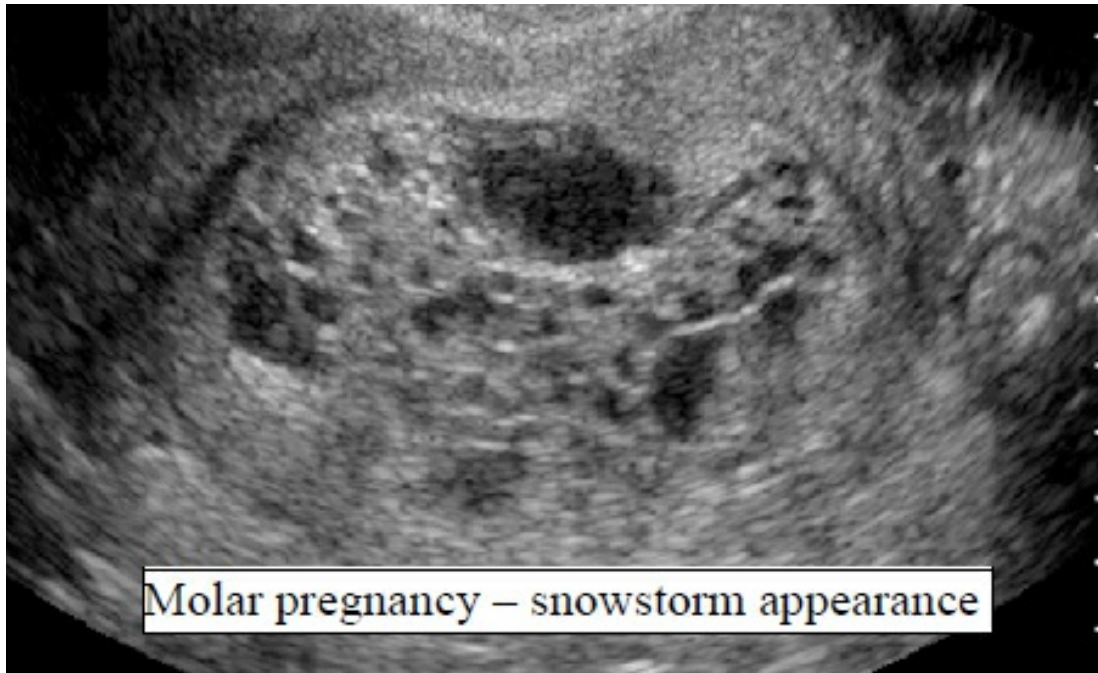
Explanation: The ideal patient for non-surgical management is hemodynamically stable with an hCG < 5000 and ectopic size < 4cm with no fetal cardiac activity. The most common side effect of methotrexate is abdominal pain 1 week later. This is known as separation pain and represents tube distension. However, any patient who returns is presumed to have a ruptured ectopic until that has been ruled out. If it is ruptured and the patient is *unstable*, laparotomy is indicated. If unruptured, salpingostomy vs salpingectomy (if no future pregnancies desired) is the procedure of choice. Some ectopic pregnancies can improve with simple watchful waiting.

- Most common cause of maternal death in first trimester: ectopic pregnancy
- Most common cause of maternal death overall: pulmonary embolism

Risk of thromboembolism is highest in the postpartum period

- RhoGAM
 - ▶ Indicated in pregnant bleeding patients who are Rh negative
 - ▶ No need for RhoGAM if mother and father are both Rh negative
 - ▶ Dose:
 - ◆ < 12 weeks = 50mcg
 - ◆ > 12 weeks = 300mcg
- **Gestational Trophoblastic Disease (GTD)**
 - ▶ Risk factors: extremes of maternal age (< 20 or > 35) and previous GTD
 - ▶ Serum hCG much higher than normal IUP levels and uterine size > gestational age
 - ▶ Associated with hyperemesis gravidarum
 - ▶ Benign GTD
 - ◆ Noncancerous tumor that develops in the uterus
 - ◆ Extra set of paternal chromosomes in a fertilized egg
 - ◆ Partial mole = contains a fetus and cardiac activity can be detected
 - ◆ Complete mole = no embryo or normal placental tissue

- ◆ hCG should be monitored after treatment to assess for persistent disease – follow levels until they are zero
- ▶ Malignant GTD
 - ◆ Invasive mole / Choriocarcinoma
 - ◆ Treatment: chemotherapy



Placental Abruption

What is it?

Premature separation of a normally implanted placenta from the uterine wall

Who gets it?

Risk factors: HTN, smoking, multiparity, cocaine use, advanced maternal age

How do they present?

Painful 3rd trimester vaginal bleeding

How is it diagnosed?

Ultrasound is a good test but cardiotocography is the best. Even with mild abruption, some degree of fetal distress is present.

Long term consequences?

Future pregnancies are at very high risk for placental abruption

Placenta Previa

What is it?

Abnormal implantation of the placenta so that it covers the internal cervical os

Who gets it?

Risk factors: multiparity, previous uterine surgery, advanced maternal age

How do they present?

Painless 3rd trimester vaginal bleeding (there is typically a sentinel bleed followed by more significant bleeding days to weeks later)

How is it diagnosed?

Ultrasound

Any other fun facts?

Pelvic exam is contraindicated – any patient with bleeding after 24 weeks should be evaluated with ultrasound to rule out placenta previa before a pelvic exam is done

Placenta Accreta

What is it?

Placenta implants with abnormal firmness into the uterine wall (ie the patient has an overly adherent placenta)

How does it present?

First clinical manifestation: profuse life threatening hemorrhage with attempted manual placental separation

Treatment?

Planned preterm cesarean hysterectomy with the placenta left in situ because attempts at removal of the placenta are associated with significant hemorrhage

Umbilical cord prolapse is a true emergency! It usually occurs at the same time as rupture of the membranes and is diagnosed by palpating the umbilical cord on vaginal exam. Prepare for an emergency C-section! In the meantime, place the patient in the knee-chest (or Trendelenburg) position. Insert a sterile gloved hand and exert manual pressure in the vagina to lift the presenting part away from the prolapsed cord. Don't release pressure until the baby is delivered.

Which of the following does not increase a woman's risk for pre-eclampsia?

- A) Pre-existing hypertension
- B) Pre-existing diabetes
- C) First pregnancy with a new partner compared to second pregnancy with the same partner
- D) Delivering a baby 18 months ago
- E) All of the above are risk factors

Answer: E

Explanation: Pre-eclampsia is defined as pregnancy beyond 20 weeks with HTN ($> 140/90$), proteinuria, and edema. Symptoms include headache, vision changes, and abdominal pain. Risk factors include extremes of maternal age, primigravid (even if it is the first pregnancy with a new partner), diabetes, HTN, obesity, and either very short (< 2 years) or very long (> 10 years) time in between pregnancies.

Treatment for pre-eclampsia consists of bedrest, BP control, and delivery (the only real treatment). Patients will have an increased risk of pre-eclampsia in future pregnancies and a higher long-term risk for diabetes and CAD overall. Importantly, pre-eclampsia may occur up to 6 weeks after delivery.

*In any pregnant woman that you are suspecting pre-eclampsia, check labs to rule out **HELLP** Syndrome: **H**emolysis, **E**levated liver enzymes, **L**ow platelets*

If a pre-eclamptic patient seizes, she now has eclampsia. The only real treatment is delivery of the fetus (again), but giving a 4-6 gram loading dose of magnesium will treat the seizures. Monitor for signs of hyperMg: decreased reflexes and respiratory depression. If these are noted, the antidote is calcium gluconate.

- **Acute Fatty Liver of Pregnancy (AFLP)**
 - ▶ Rare disorder seen in 3rd trimester; nausea/vomiting with epigastric pain and liver dysfunction
 - ▶ Coagulation abnormalities can be present (unlike HELLP syndrome)

- ▶ Hypoglycemia and high ammonia levels are unique to AFLP

Just to drive home the point one more time, which of the following lab findings would be expected in a patient with HELLP syndrome?

- A) Low hemoglobin
- B) Prolonged PT
- C) Prolonged aPTT
- D) All of the above

Answer: A

Explanation: Coagulation abnormalities are not seen in cases of HELLP syndrome.

Which of the following is true regarding appendicitis in pregnancy?

- A) Patients in the first trimester are more likely to have right upper quadrant pain
- B) Patients may have a physiologic increase in WBC up to 25,000 so this test is particularly not helpful in this population
- C) Patients in the third trimester are more likely to have right lower quadrant pain
- D) Appendicitis is the most common surgical emergency of pregnancy

Answer: D

Explanation: Appendicitis is the most common surgical emergency of pregnancy, despite having the same incidence as in non-pregnant patients. Patients in the first trimester are more likely to have right lower quadrant pain that migrates to the right upper quadrant and flank in the third trimester. Physiologic increases in the WBC count occur in pregnancy up to 18,000 – anything beyond this should raise suspicion for some other process occurring.

- Drugs which are contraindicated in pregnancy:
 - ▶ Sulfonamides

- ▶ Aspirin
- ▶ Fluoroquinolones
- ▶ Erythromycin (macrolides)
- ▶ Tetracyclines
- ▶ NSAIDs
- ▶ ACE inhibitors
- ▶ Warfarin
- ▶ Most anticonvulsants

*** The first step in ACLS care of a pregnant woman is to displace the uterus
– *then* start chest compressions ***

- Trauma in Pregnancy
 - ▶ Initial trauma care is the same as in non-pregnant patients
 - ▶ Turn patients on their left side *or manually displace the uterus* to relieve pressure on the IVC and avoid hypotension
 - ▶ Chest tubes should be inserted 1-2 intercostal spaces higher than normal
 - ▶ All trauma patients ≥ 23 weeks need at least 4 hours of fetal monitoring
 - ▶ No radiologic test should be withheld if needed for maternal evaluation – maternal stabilization is the most important factor in fetal survival
 - ▶ Consider RhoGAM if there is abdominal trauma
- There are no FDA-approved medications for **tocolysis** and there are several **contraindications**:
 - ▶ Fetus > 34 weeks gestation
 - ▶ Fetus weighs < 2500 grams
 - ▶ Cervix dilated > 4 cm
 - ▶ Chorioamnionitis or other intrauterine infection is present
- Premature Rupture of Membranes (PROM)
 - ▶ Rupture prior to onset of labor
 - ▶ Associated with frequency of digital pelvic exams
 - ▶ Sterile speculum exam should be done first

- ▶ **Ferning** (dried amniotic fluid allowed to air dry on a slide) **is the most specific test**. Positive nitrazine test (blue or blue-green color of nitrazine paper after exposure to fluid) is sensitive but not very specific (false positive: blood, semen, trichomonas)
- ▶ *Normal vaginal pH in pregnancy: 3.5-6; pH of amniotic fluid: 7.1-7.3*
- ▶ All patients should receive antibiotics to prevent chorioamnionitis
- ▶ Management: avoid doing too many vaginal exams. If the cervix is favorable, deliver. If not, ripen the cervix and induce labor.

Which of the following most often complicates normal vaginal delivery?

- A) Breech presentation
- B) Clavicle fracture
- C) Abnormal fetal lie
- D) Shoulder dystocia

Answer: A

Explanation: In breech presentation, the head is in the uterine fundus while the buttocks are the presenting part – the buttocks cannot dilate the cervix as well as the head can, so inadequate cervical dilation is a common problem.

Shoulder Dystocia: Use the McRoberts maneuver to widen the pelvis by placing the patient in the extreme lithotomy position (legs sharply flexed and held up to the abdomen) and then apply suprapubic pressure



Episiotomy: **oblique episiotomy is the preferred technique and avoids cutting the perineum**; midline episiotomy involves an incision centrally over the anus whereby the perineum is bifurcated

A patient is delivering and all of a sudden they become hypotensive, hypoxic, and have respiratory failure. Sounds like a pulmonary embolism right? Well it could be an **amniotic fluid embolism**. Treatment is supportive.

Now say the patient is in their last month of pregnancy and starts to show lower extremity edema, dyspnea on exertion, and other symptoms of congestive heart failure. Whether they're in their **last month or up to five months post delivery**, consider **peripartum cardiomyopathy**. Risk factors include advanced maternal age, pregnancy with multiple fetuses, history of pre/eclampsia, and maternal cocaine abuse. Treatment is the same as other types of heart failure and be aware that future pregnancies puts the mother at very high risk for death. Sadly, the mother may not be able to have any more children.

- **Postpartum Hemorrhage**

- ▶ *Uterine atony* is the most common cause and can be diagnosed by finding an enlarged, soft, 'doughy' uterus
 - ◆ Treatment: fundal massage, oxytocin, supportive care

- ▶ Retained products (in particular the placenta) is the second most common cause, and should especially be considered in delayed hemorrhage
- ▶ *Uterine rupture* can occur if attempting vaginal birth after C-section
- ▶ *Uterine inversion* is caused by excessive traction on umbilical cord
 - ◆ Treatment: manual reduction or emergent laparotomy
- **Endometritis**
 - ▶ Fever, abdominal pain, uterine tenderness, malodorous lochia
 - ▶ Polymicrobial infection
 - ▶ #1 risk factor: C-section
 - ▶ Other risk factors include prolonged rupture of membranes and undergoing multiple vaginal examinations with long labor
 - ▶ Treatment: antibiotics (clindamycin + gentamicin)

What should you know about mastitis?

‘mast’ = breast while ‘itis’ = inflammation or infection

So a painful swollen breast is ‘mastitis’. It’s usually caused by *S. aureus* and treatment is to continue breast feeding while taking antibiotics like dicloxacillin or cephalexin.

Neonatal mastitis?

In an otherwise well-appearing afebrile neonate, obtain a culture of nipple discharge and start a penicillin or cephalosporin antibiotic.



**OPERATIONAL /
ADMINISTRATIVE**

- The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) creates the standards for emergency department accreditation
 - ▶ Sets standards related to patient safety and quality assurance
 - ▶ Full accreditation lasts for three years

Which federal agency oversees emergency medical services?

The National Highway Safety and Traffic Administration (part of the DOT)

Which of the following has the highest level of training?

- A) Emergency medical technician (EMT)
- B) Emergency medical technician-paramedic (EMT-P)
- C) Advanced emergency medical technician (A-EMT)
- D) Emergency medical technician-intermediate (EMT-I)

Answer: B

Explanation: An EMT is certified to perform CPR. An EMT-B (basic) can perform CPR in addition to noninvasive measures such as bag-valve-mask, splinting, and holding pressure on a bleeding site. EMT-I is the same as an A-EMT, and these providers can place IVs and give limited drugs (D50 for instance). EMT-P are the most advanced providers.

- An ambulance staffed by EMT-Bs is considered a BLS ambulance
- An ambulance staffed by EMT-Ps is considered an ACLS ambulance
- BLS ambulances are stocked with different supplies and equipment than ACLS ones
- Paramedics act under a physician's license; the ultimate responsibility lies with the local EMS director
- EMS medical directors do not have to be board certified in emergency

medicine

What's the difference between online and offline medical control?

Online medical control involves EMS providers speaking directly with a physician in real-time over the phone or radio to receive input on patient care
Offline medical control refers to standing orders that EMS providers can refer to

- If parents refuse life-saving treatment for their child, prehospital providers *do not* need to contact online medical control and *can* provide treatment for the child
- **E-911:** when the telephone number of a 911 caller is displayed at the operator's console
- Public-private EMS model: public fire department provides first response and is later met by a private ambulance service
- Third-service EMS model: municipal dept itself operates ambulances and provides personnel to respond to calls
- Station-based EMS model: fire departments are used to respond to all calls
- **Intraosseus (IO) Access**
 - ▶ Preferred access site for children and adults who do not have readily available peripheral access and who require resuscitation
 - ▶ Any IV drug or resuscitative fluid can be given through an IO
 - ▶ Drug and fluid dosing is the same (however adenosine may not be as effective as when given through a vein closer to the heart)
 - ▶ **Contraindications**
 - ◆ Suspected fracture
 - ◆ Extremity with vascular interruption
 - ◆ Cellulitis, burns, or osteomyelitis in the desired bone
 - ▶ Preferred site: proximal humerus (adults) or proximal tibia (children)
 - ▶ Use of an IO beyond 24 hours is associated with development of

osteomyelitis

Which phase of a hospital emergency operations plan involves establishing an incident command system?

- A) Response
- B) Preparedness
- C) Recovery
- D) Mitigation planning

Answer: A

Explanation: Emergency operations plans (aka 'disaster plans') ensure that a hospital has an organized response to disasters and potential mass casualty situations. The four phases are preparedness (developing a plan prior to the disaster), mitigation planning (starts after the disaster occurs; involves identifying initial actions that need to be taken), response (entails all necessary steps to resolve the disaster, including activating the plan and establishing a command system), and recovery. Disaster plans need to be exercised at least twice per year.

Mass casualty situations:

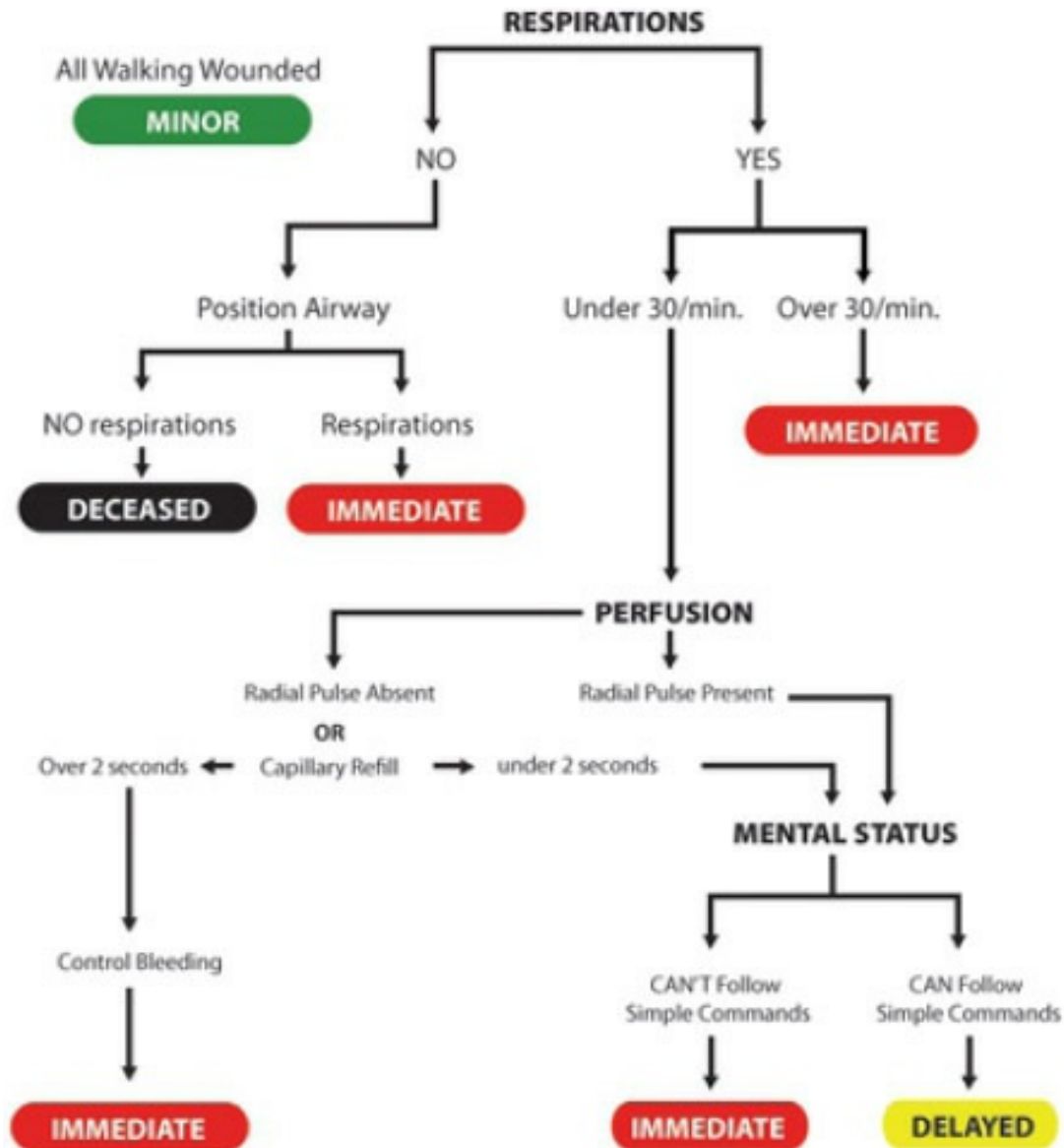
Police are responsible for establishing outer perimeter (crowd control)

Fire is in charge of extrication and hazardous materials

Communication is the earliest problem in disasters while a lack of support is the most common problem

Simple Triage and Rapid Treatment (START): a strategy first responders use to quickly triage victims

A = No respirations
B = RR > 30
C = Cap<2s / No Rad Pulse
D = Can't follow commands
Not green, red or black
Can walk away



Here's what you need to know about triage during a mass casualty: patients are tagged with one of the four colors. Patients who are 'black' are either dead or dying. If a quick reposition of the airway fails to jump start respirations, that patient will probably die even with the best resuscitative efforts. Patients who are tagged 'red' need immediate attention. Anyone who can walk is tagged 'green'.

- Emergency Medical Treatment and Active Labor Act (**EMTALA**) was passed in 1986 to prevent 'patient dumping' (refusing to care for patients based on insurance status). It essentially mandates that all

persons who present to an ER receive a medical screening exam. VA and military hospitals are exempt.

A patient involved in a motor vehicle accident is unresponsive and critically ill. He is taken to the nearest ED despite all parties knowing that there is no trauma surgeon available there. With IV fluid resuscitation and blood transfusion he remains hypotensive. The physician notes free fluid in Morrison's pouch during the FAST exam. Lacking access to a surgeon, the patient is transferred to a hospital 50 miles away. En route to the accepting hospital, the patient goes into cardiac arrest and dies. Who carries the greatest responsibility for this outcome?

- A) The transferring physician
- B) The accepting physician
- C) The initial ambulance crew for not diverting him immediately
- D) Everyone is equally responsible

Answer: A

Explanation: Any harm to a patient during a transfer is the responsibility of the doctor *who ordered the transfer*. That's not to say the transferring physician made a poor decision, rather to highlight that it is not the accepting physician's responsibility.

A 40 year old male is in an MVA and brought to a rural emergency department. Blood pressure is 105/60 and HR is 100. He has a GCS of 13 with evidence of a flail chest and multiple rib fractures, gross hematuria, and suspicion for an open book fracture. The patient requires transfer to a trauma center which is 30 miles away. Which step should be taken first?

These types of questions are the bane of any test-taker. Options will include intubation, chest tube placement, discussion with family re: need for transfer, or **calling the receiving hospital and speaking to a surgeon**. In reality, any of the above steps could be taken, but the question is asking which should be done *first*. Since the patient is hemodynamically stable, intubation and chest

tube placement are unnecessary right now (at least from the information given). Family discussion is important but nothing should delay transfer except for a life-saving intervention.

- Child abuse and elderly abuse are mandatory reportable offenses
- Spousal abuse/domestic violence is not a mandatory reportable offense
- Most patients will not report domestic violence unless specifically asked in the absence of their partner; screening is the only way to accurately evaluate rate of domestic violence amongst ED patients
 - ▶ Most violence against women is done by intimate partners
 - ▶ Most violence against men is done by strangers

Which of the following patients is at greater risk for sexual assault?

- A) Male victim
- B) Persons aged 25-40
- C) Persons aged 65 and older
- D) Higher socioeconomic status
- E) Physically or mentally disabled

Answer: E

Explanation: Populations that are at higher risk of sexual assault include those of age 25 or under, lower socioeconomic status, alcohol or drug abusers, and physical or mental disability. Females are more frequently victims as well.

Which of the following patients should receive post-exposure prophylaxis in the ER following a suspected rape?

- A) Those with confirmed STD
- B) Cases where the assailant is suspected of being positive for any type of infection
- C) Those whose urine sample reveals infection
- D) All suspected rape cases

Answer: D

- The risk of pregnancy after a rape is approximately 5% and can be lowered if emergency contraception is taken. Two options: 'Plan B' is progestin-only and is available over the counter. Ulipristal ('ella') may be more effective but requires a prescription. Plan B works for up to four days after intercourse; Ulipristal works for up to five days.
- Competence is a legal term – if a patient refuses care you must determine if they have decision-making capacity. In order to have capacity to decline care, a patient must:
 - ▶ Understand the treatment options
 - ▶ Be aware of the consequences of declining care
 - ▶ Understand the risks and benefits of their decision
- **The 4 components of Informed Consent:**
 - 1) Nature of the procedure
 - 2) Most significant risks of the procedure
 - 3) Benefits of the procedure
 - 4) Any possible alternatives to the procedure, including the risks of not having anything done (when that is a legitimate option)
- **Therapeutic privilege** is an exception to informed consent - if giving the information would severely harm the patient or undermine the informed consent process it is okay to withhold the information
- **Suicidal patients cannot give or withhold consent**
- Minor consent laws vary from state to state
- An emancipated minor is one that is self-supporting, married, or pregnant
 - ▶ **A minor that has a child is not considered emancipated**
- All states have a statutory exemption allowing minors to consent to testing and treatment for STDs, drug abuse, and pregnancy-related care

- You cannot deny life-saving transfusions or procedures for a minor, even if parents will not consent

This specific scenario may arise in the setting of a Jehovah's Witness. In such cases, parents of a minor may not refuse life-saving transfusions or procedures. They *may* refuse minor recommendations. Speaking of Jehovah's Witnesses, they will typically not accept blood, plasma, platelet, or autologous transfusions on the basis of religious grounds. However, they will accept hemodialysis.

- DNR orders apply to respiratory and cardiac arrest only – they do not imply refusal of care or inability to admit to a hospital
 - ▶ If unclear regarding the presence of a DNR order, resuscitate
- Studies have shown that families who observe a resuscitation are less likely to experience PTSD, anxiety, and depression and more satisfied with staff efforts compared to those who did not witness the resuscitation

What is responsible for the largest percentage of medical errors in the ER?

Medication errors (more than lab or radiology). Having dedicated ER pharmacists, electronic medical records, and barcoding has reduced the incidence of errors.

- **4 elements required to prove malpractice:**
 - ▶ Duty = the physician had a duty to care for the patient
 - ▶ Breach = the duty was not performed to the level of the generally accepted standard of care
 - ◆ Malfeasance: performing an action that should not have been done
 - ◆ Misfeasance: performing an action in an improper way
 - ◆ Nonfeasance: failure to perform an action
 - ▶ Injury = an injury occurred
 - ▶ Causation = the breach of duty caused the injury
- Types of Malpractice Coverage

- ▶ Occurrence-based policy: Policy provides coverage if the event occurred during the policy period, regardless of when the claim is filed (provides tail-coverage)
 - ▶ Claims-made policy: Covers claims made during the policy period (does not include tail-coverage)
 - ▶ Prior acts coverage: Covers claims made during the current policy period on events that occurred before the policy went into effect
- The most common complaint with regard to physicians is misdiagnosis
 - The most common complaints overall deal with inappropriate billing
- In dealing with potentially violent patients, approach the patient in a calm and controlled manner – avoid excessive eye contact but maintain *some*; exits and doors should be readily accessible to both the physician and the patient and should be unblocked
 - After a patient is restrained they need to be monitored for pressure sores, rhabdomyolysis, and potential life-threatening metabolic acidosis
 - Ischemic heart disease is the leading cause of death in the US among all patients

Which of the following has the largest impact on job satisfaction for emergency medicine physicians?

- A) Number of consecutive night shifts
- B) Acuity of patients
- C) Location of the hospital
- D) Relationship with colleagues
- E) Salary

Answer: A

Explanation: Studies have consistently shown that disrupting circadian rhythms and consistent night-shift work is associated with lower levels of job satisfaction. While all of the factors listed are important, the number of

consecutive night shifts is the most important.

- The Sunshine Act requires drug manufacturers and pharmaceutical companies to report certain payments and benefits given to physicians. The data is entered into a publicly searchable database. Any payment greater than \$10 must be reported.



OPHTHALMOLOGY

Cranial Nerve Palsies:

Cranial Nerve III palsies can be congenital or acquired. When acquired, it can be due to trauma, tumor, aneurysm, diabetes, etc. The key is knowing when it's something emergent and potentially surgical vs when it's something treated with medical management.

First, the presentation: ptosis, **mydriasis**, eye is 'down and out'

Ptosis is typically the most noticeable finding on exam and is complete Any new CN III palsy *with pupillary involvement* needs an MRA/CTA to evaluate for an aneurysm



What do you mean CN III palsy *with pupillary involvement*? When is the pupil not involved? Fibers that supply the pupillary constrictors are superficial, therefore **if CN III palsy is due to an aneurysm, pupil will be involved. If CN III palsy is due to diabetes/HTN, pupil will be spared**

Cranial Nerve III palsies should be distinguished from Horner's syndrome In Horner's Syndrome, patients present with ptosis, miosis, and anhidrosis Ptosis is very mild and incomplete (because CN III is still intact)

Topical cocaine makes the diagnosis: normally both pupils will dilate in response; with Horner's syndrome the affected pupil won't dilate

Acute onset of Horner's syndrome is considered a neurologic emergency and warrants immediate CT scan of the brain and CTA to

rule out carotid artery dissection

CN VI palsy: the eyes are deviated medially

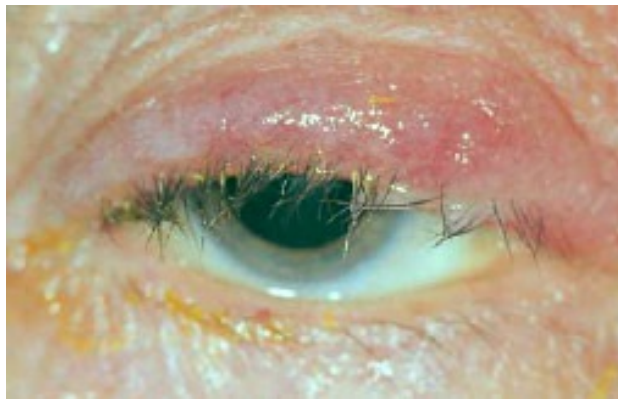
Right CN VI palsy



Right CN VI palsy



Eyelids:



Diagnosis?

If you said 'blepharitis' then you are 'blepha-right'!!

Blepharitis is a chronic staph infection of the eyelid margins. Treatment involves 'eyelid hygiene' with warm compresses, baby shampoo, and topical antibiotics.

Canalicular trauma refers to an injury causing damage to the lacrimal

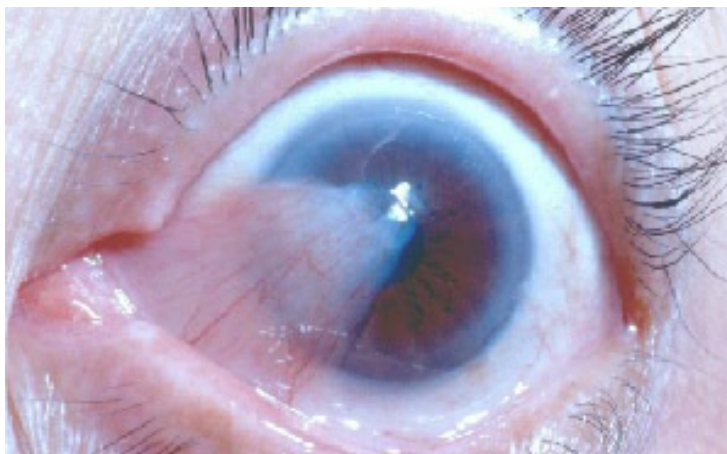
draining system of the eye, which is located near the medial canthus. Fluoroscein staining can help confirm damage to the lacrimal system and a specialist should be consulted for repair.

What is this condition?



If you said ‘dacryocystitis’ then you’re doing a ‘dacrocyst-astic’ job!!

This is an infection of the lacrimal sac typically due to obstruction of outflow. Management includes warm compresses and *oral* antibiotics, ultimately abscess drainage may be necessary.



Pterygium: wing-shaped growth of connective tissue that extends onto the cornea. It forms in response to prolonged early sun exposure and damage from UV rays. No treatment is necessary unless vision is affected, in which case it can be removed.

Be able to distinguish a chalazion from a sty:

A **chalazion** is a **chronic** painless inflammation of the meibomian gland due to gland obstruction from oily secretions. Treatment: antibiotics are generally not warranted.



A sty, also known as a hordeolum, is a red painful bump near the eyelid. It can be external (develops at the base of the eyelash if the eyelash follicle is involved) or internal (under the eyelid due to infection of the meibomian glands). Treatment is warm compresses and topical antibiotics.



Conjunctivitis

Most cases are viral and predominately associated with adenovirus. Viral conjunctivitis produces a watery discharge that classically starts in one eye and spreads to the other. Preauricular lymphadenopathy is a classic exam finding. Treatment is warm compresses as antibiotics are futile.

Bacterial conjunctivitis on the other hand produces a purulent discharge. While all but the most severe cases will heal on their own, antibiotics are typically recommended to shorten duration of symptoms. Allergic conjunctivitis produces a thin watery discharge that affects both eyes from the onset. Patients have itchy eyes, rhinorrhea, and other allergy symptoms. Treatment is naphazoline.



These are conjunctival papillae, seen in patients with allergic conjunctivitis

Neonatal conjunctivitis refers to that which is acquired in the birth canal

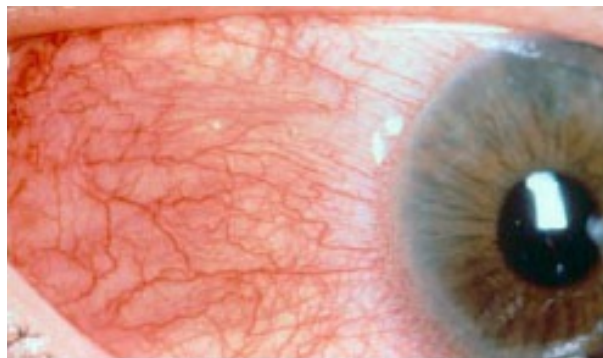
- 24-48 hours postpartum: chemical
- 3-5 days postpartum: gonococcal (treatment: IV ceftriaxone *and* topical erythromycin)
- 5-14 days postpartum: chlamydia (treatment: oral *and* topical erythromycin)

Other important conditions:

- Episcleritis
 - ▶ Sudden onset pain and redness isolated to the episclera
 - ▶ Treatment: oral NSAIDs



- Scleritis
 - ▶ Severe pain and redness, diffuse scleral involvement
 - ▶ Violet purple discoloration of the globe may show through
 - ▶ Associated with underlying disease (rheumatoid arthritis commonly)
 - ▶ Treatment: high dose steroids and ophthalmology consultation



- Subconjunctival Hemorrhage
 - ▶ Can be due to sneezing, coughing, straining, or post-traumatic
 - ▶ No treatment required
- Anterior Uveitis aka Iritis
 - ▶ Can be infectious, post-traumatic, or associated with autoimmune diseases
 - ▶ Patients typically present with severe eye pain, tearing, and both **direct and consensual photophobia**
 - ▶ Slit lamp may show 'cell' (refers to white blood cells) and 'flare' (refers to foggy appearance of protein which has leaked from blood vessels)

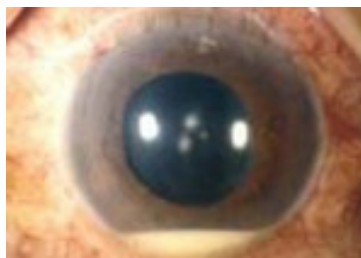
- ▶ The pupil *can* be misshapen on exam
- ▶ Treatment: topical cycloplegics and topical steroids – ophthalmology should always be consulted before topical steroids are initiated in the ER



- Corneal Abrasion
 - ▶ Symptoms: tearing, foreign body sensation, photophobia, injection
 - ▶ Remember to evert the eyelid to rule out an occult foreign body
 - ▶ Recurrent pain a few days after resolution of symptoms can be a sign of recurrent corneal erosion (in other words, the newly healed corneal epithelium has sloughed off)
 - ▶ Never place a protective shield over the eye as this can worsen infection

There are VERY few times you should place a **shield over the eye**: examples of cases where you may include **hyphema and globe rupture**. Keep reading for more information!

- Hypopyon
 - ▶ Pus in the anterior chamber (layering of white blood cells)
 - ▶ Seen in anterior uveitis and corneal ulcers



- Corneal Ulcer
 - ▶ Severe corneal infection associated with trauma or prolonged contact lens wear
 - ▶ Patients present with pain, photophobia, excessive tears, and foreign body sensation
 - ▶ Exam shows a corneal defect with surrounding white hazy infiltrate
 - ▶ This is a true ocular emergency and can lead to blindness if not treated promptly. Consult ophthalmology! Patients need an eye culture and should be started on topical quinolone drops.



- Endophthalmitis
 - ▶ Bacterial or fungal infection within the eye
 - ◆ Post-cataract endophthalmitis is the most common form and occurs within six weeks of cataract surgery
 - ▶ Patients present with eye pain, blurry vision, and 'hazy retina' on exam
 - ▶ Most common bacteria: coag-negative staph
 - ▶ Consult ophthalmology emergently; treatment includes *direct injection of antibiotics into the eye*
- Chemical burns: irrigate the eye quickly; acid burns are not usually associated with deep penetration (coagulation necrosis) compared to alkali burns (liquefactive necrosis).
- Ultraviolet Keratitis

- ▶ “Snow blindness” in skiers, welders, tanning boothers, etc
- ▶ On exam, patients will have diffuse bilateral punctate keratitis
- ▶ Treatment: analgesics and topical antibiotics - cycloplegics will help with photophobia but should be avoided as they can cause pupillary dilation lasting days, which can be painful for the patient
- HSV keratitis: fluorescein stain shows dendritic pattern/branching; treatment: oral or topical antivirals (acyclovir)

The question then is, what is the difference between herpes simplex keratitis and herpes zoster ophthalmicus? Keratitis involves pretty much just the cornea – so you’ll see a dendritic pattern but not much on the skin itself. HZO will give you keratitis PLUS involvement of the ophthalmic branch of CN V – hence the rash. There is usually a prodrome of a flu-like illness and treatment involves oral antivirals, topical steroids, and consideration of IV antivirals.



- Periorbital (Preseptal) Cellulitis vs Orbital Cellulitis
 - ▶ Periorbital cellulitis is a superficial infection of the eyelids that does not extend past the orbital septum. Most cases result from hematogenous spread and the most common organisms are staph, group A strep, and strep pneumo (yes, you actually need to know these).
 - ▶ It is critical to distinguish preorbital from orbital cellulitis. This can typically be done by physical exam. In cases of orbital cellulitis patients will have proptosis, painful eye movements, and potentially

decreased vision. Most cases of orbital cellulitis result from direct spread of adjacent infection (like a sinusitis for instance) as opposed to the hematogenous spread of periorbital cellulitis.

◆ If orbital involvement cannot be excluded clinically, obtain a CT scan of the orbits

- ▶ Periorbital cases can be treated with amoxicillin/clavulanate while orbital cellulitis should be admitted for IV antibiotics

- **Hyphema**

- ▶ Blood in the anterior chamber usually from trauma
- ▶ Can occur spontaneously (in sickle cell patients or those who are anticoagulated)
- ▶ Have the patient sit upright, place an eye shield, and rule out other injuries. Topical steroids may be of benefit, but once again this should always be discussed with ophthalmology before initiating.
- ▶ Measure IOP (treat as you would any other case except avoid acetazolamide in patients who could potentially have sickle cell disease)
- ▶ There is a high risk to re-bleed in 3-5 days



- Acute Angle Closure Glaucoma

- ▶ Painful red eye that is worsened when placed in dim or dark rooms
- ▶ Can be associated with abdominal pain and nausea/vomiting
- ▶ Patients may have a hazy cornea, fixed mid-dilated pupil, and increased
- ▶ IOP (normal IOP is 10-20)
- ▶ Treatment: beta blocker (timolol), alpha agonist (apraclonidine), acetazolamide, pilocarpine (miotic), ophthalmology consult

- Retinal Detachment vs Vitreous Hemorrhage

If a patient presents with new and sudden onset of floaters or flashes of light with loss of vision, consider retinal detachment or vitreous hemorrhage.

Retinal detachment is rare but if diagnosed it's typically in an elderly person who's very myopic. Patients will classically report vision loss as a 'curtain coming down' and it may be progressive over days or weeks. The extent of detachment determines how urgently it needs to be repaired: if central acuity is preserved (vision 20/40 for instance), surgery may be more urgent (within 24 hours). If vision is poor (20/200 for instance), surgery can be delayed for approximately one week. Either way, patients should be referred for close outpatient follow-up.

Vitreous hemorrhage or detachment can also be described as new onset floaters, flashes of light, and curtain-coming-down vision loss. It's common in the elderly, myopics (seeing a pattern here?), but also in diabetics. Patients will often also report a similar history of something happening to them in the past. The extent of vision loss again determines the urgency with which patients need to see an ophthalmologist – same rules as above: close follow-up.

- Blowout Fracture

What is it?

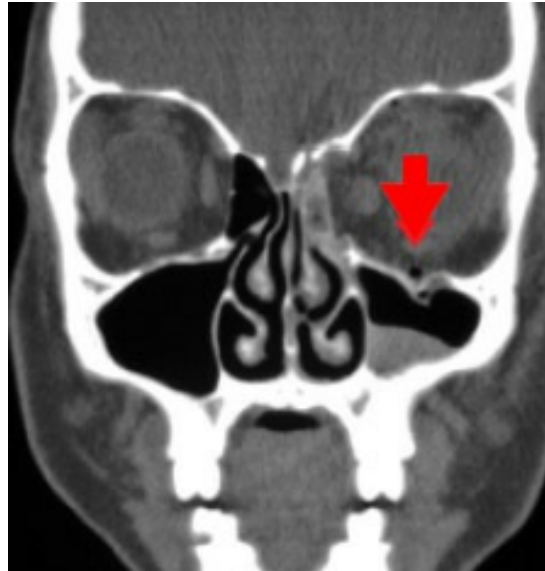
A 'blowout' is when one team demolishes another, right? Well imagine the first team is some sort of high-velocity object and the second team is your orbital floor.

Okay, so the orbital floor is fractured. What happens next?

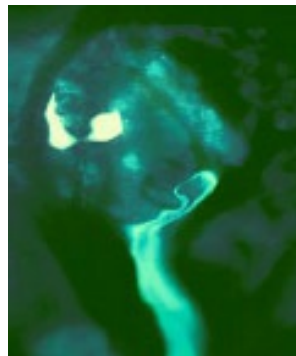
The orbit contains fat which holds the globe in place. Fracture can result in displacement of the fat ('teardrop sign' on CT) and subsequent **enophthalmos**.

Any structures to worry about?

The infraorbital nerve is just below the orbital floor and can get paresthetized. The inferior rectus and inferior oblique muscles run along the floor and can get entrapped – manifesting as diplopia on upward gaze.

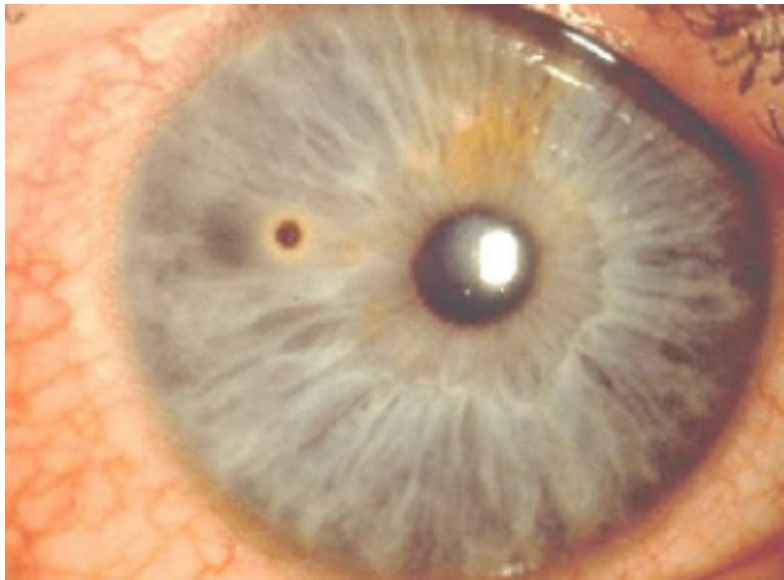


- Penetrating Trauma / Globe Rupture
 - ▶ Signs: Severe subconjunctival hemorrhage, hyphema, teardrop-shaped pupil
 - ▶ **Seidel sign** = fluorescein instilled → bright green stream/waterfall



- ▶ Once a globe injury is suspected, avoid any further manipulation and notify ophtho immediately. *Do NOT check IOP*. Just put a shield on the eye, start IV antibiotics, give antiemetics, and talk to a specialist!
- ▶ In cases of an eyelid laceration, the presence of fat protruding from the laceration indicates a likely globe injury (eyelids don't contain subcutaneous fat)
- Metallic foreign body can be seen in welders and construction workers. Metal is toxic to the retina and a rust ring can form within 24 hours. If

there's a superficial foreign body on the eye, a cotton tip can be used to assist in removal – but once it's an embedded foreign body and there is a rust ring, you may need a 25 or 30 gauge needle, a good slit lamp, and a steady hand to remove it. Always consider intraocular foreign bodies in cases where patients have the sensation of a piece of metal flying into their eye.



If someone is on the receiving end of blunt trauma to the face and has pain in/around the eye, consider a diagnosis of retrobulbar hematoma. Patients may have proptosis and a dilated/nonreactive pupil. They can develop acute orbital compartment syndrome and treatment is a lateral canthotomy. The primary indications for a lateral canthotomy are proptosis, decreased visual acuity, or an intraocular pressure > 40 .

What is the difference between a central retinal artery (CRAO) and central retinal vein (CRVO) occlusion?

Both cause painless loss of vision; CRAO is a little more sudden

CRAO produces a pale retina (due to retinal edema), 'boxcarring' (interrupted columns of blood within the retinal vessels, and a 'cherry-red spot'. CRVO causes a 'blood and thunder' appearance, cotton wool spots, and retinal hemorrhages.

Any difference in treatment?

The first step is to immediately lower any elevations in intraocular pressure. CRAO may benefit from hyperbaric oxygen therapy. Carbogen (5% CO₂, 95% O₂) may be beneficial. Use of thrombolytics is also being studied.

CRAO requires emergent consult and gentle globe massage to dislodge the embolus.

CRVO has no acute treatment (aspirin no longer recommended routinely)

Disposition?

CRAO patients warrant emergent ophthalmology consult and admission for full stroke workup.

CRVO needs urgent consultation but no anticoagulation or other treatment.

Your next patient is an elderly woman with headache and slight tenderness over the temporal artery:

What are you concerned about? **Temporal arteritis**

How do you confirm the diagnosis? Temporal artery biopsy

What should you do? Wait two days for biopsy results? No, start steroids!

How should steroids be given? **If there are no signs of ischemic damage (ie vision loss), start prednisone 60mg PO.** Patients will need to be tapered slowly over 9-12 months (!)

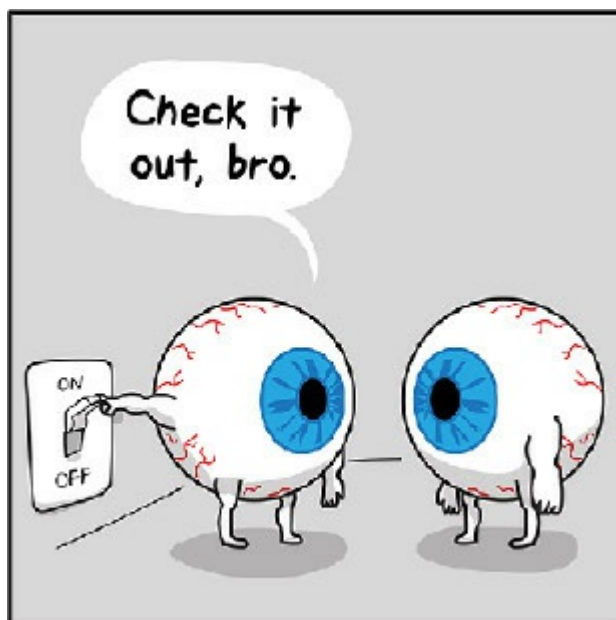
What **if there is vision loss**? Administer **solumedrol 1000mg IV daily for three days**

ESR may be high but that won't make or break your decision

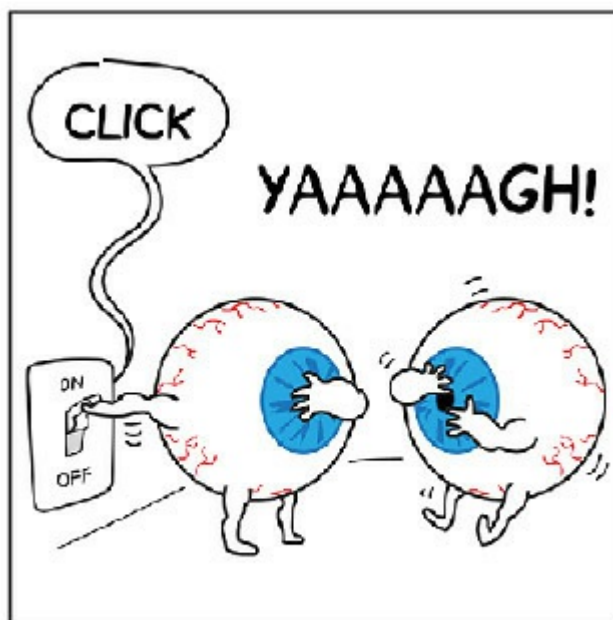
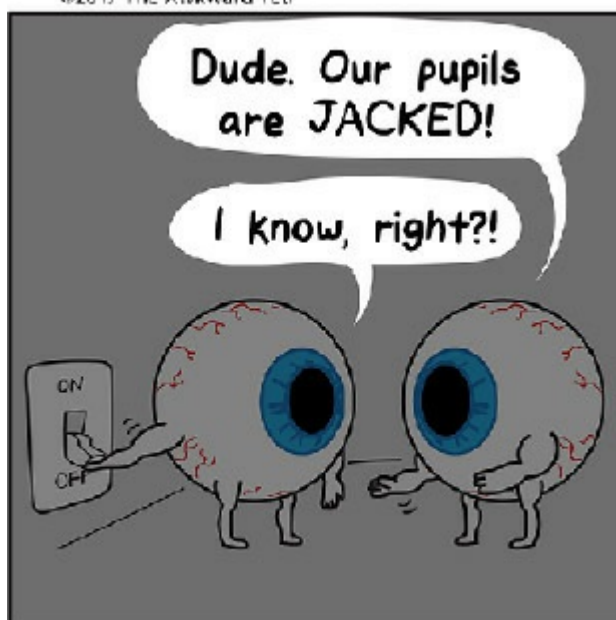
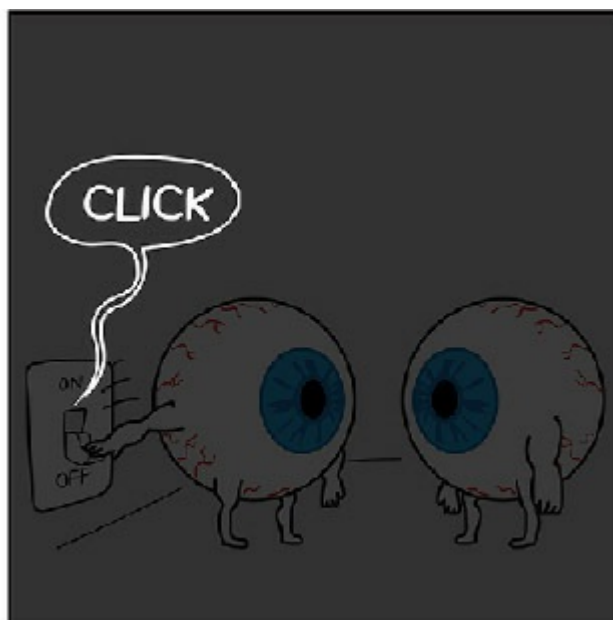
Any other boards-y type stuff to know about temporal arteritis?

Most sensitive finding: new headache

Most specific finding: jaw claudication



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CARDIOLOGY

Which of the following statements is true regarding cardiac arrest in children?

- A) Ventricular fibrillation is the most common arrest rhythm
- B) Ventricular tachycardia is the most common arrest rhythm
- C) Cardiac arrest in children is more often due to respiratory causes than cardiac causes
- D) Children less than six years of age can undergo surgical cricothyrotomy if necessary to secure an airway

Answer: C

Explanation: Respiratory arrest is the most common cause of cardiac arrest in children. When cardiac in etiology, asystole is the most common arrest rhythm. Surgical cricothyrotomy is not recommended for children < 8 years of age.

Initial defibrillation voltage in children is 2 J/kg followed by 4 J/kg for subsequent shocks

Beware bradycardia! Bradycardia in a newborn is most commonly an indicator of hypoxemia and remember that chest compressions should be started in infants with HR < 60

Tetralogy of Fallot: a great topic for test writers to torture you about. It's a collection of four cardiac abnormalities: ventricular septal defect (VSD), RV hypertrophy, RV outflow obstruction, and the presence of an overriding aorta. These defects lead to a right to left shunt through the VSD and subsequent cyanosis *that may or may not be present at birth*. Diagnosis is by echocardiogram. You won't be asked about any of that. What you might be asked about is 'Tet spells': these are cyanotic episodes that are precipitated by a decrease in systemic vascular resistance (which can be from crying,

defecating, exertion during feeding, etc). This leads to increased shunting and a vicious cycle that can last 15-30 minutes and either resolve or can spiral down to seizures and even death. Treatment involves high-flow oxygen, consoling the child, placing the child in the knee-chest (squatting) position, and correcting underlying causes such as arrhythmias, hypothermia, or hypoglycemia. In severe spells, consider morphine (to calm the child) and sodium bicarb to treat acidosis.

CRITICAL CARE

Which of the following is a difference between pediatric and adult airways?

- A) Children have a relatively smaller tongue
- B) Infants' vocal cords are angled differently leading to difficult nasal intubations
- C) Larynx is located higher in the neck in adults
- D) The cricoid cartilage represents the narrowest part of an adult's airway

Answer: B

Explanation: Children's airways are very different from adults. Children have a relatively larger tongue and more anterior cords – these are the two biggest differences. The narrowest part of a child's airway (until age 5) is at the level of the cricoid cartilage (as opposed to the glottis in an adult).

It's more common to intubate the right mainstem bronchus in a child due to a shorter trachea

- Pediatric Rehydration
 - ▶ Fluid bolus of 20mL/kg NS
 - ▶ Maintenance fluids – 4/2/1 rule
 - ◆ 4mL/kg for first 10kg

- ◆ 2mL/kg for next 10kg
- ◆ 1mL/kg for each additional kg

- **Sepsis**
 - ▶ Important causes: Group B Strep, E. coli, Listeria
 - ▶ Newborns and infants should generally receive ampicillin + gentamicin/ceftriaxone
- Inconsolable Crying
 - ▶ “Colic” refers to infants who cry for no apparent reason during the first 3 months of life; it’s self-limited and is the most common cause of excess crying
 - ▶ Causes include infection, hair tourniquet syndrome, trauma (consider abuse, corneal abrasions, etc), incarcerated hernia, testicular torsion
- Bilateral retinal hemorrhages: present in almost half of all neonates due to normal birth trauma; consider child abuse in infants
- Clavicle fractures are the most commonly reported fractures in newborns
- Sudden Infant Death Syndrome (SIDS)

Leading cause of mortality between 1 month and 1 year of age in the US

Definition: sudden death of an infant < 1 year of age, which remains unexplained after a thorough investigation (including autopsy)

What will you be asked about it: Risk factors! **Smoking during pregnancy**, young maternal age, lack of prenatal care, preterm baby, and sleeping prone. So if you’re given a list and have to choose between advanced maternal age and smoking, remember that it’s smoking and *low* maternal age.

Use of home monitors has not been proven to reduce incidence

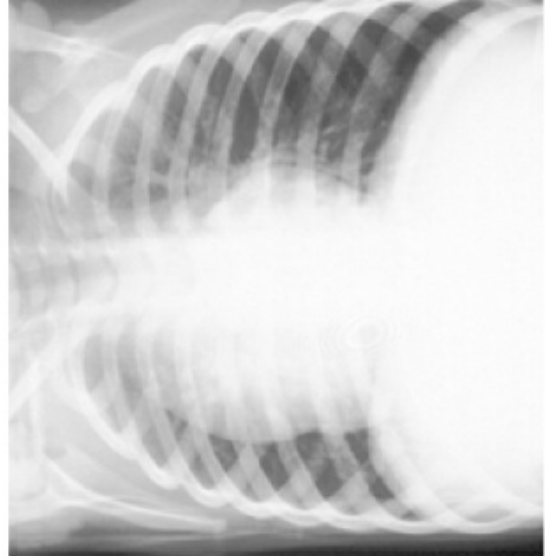
PULMONARY

- Foreign Body Aspiration
 - ▶ Think of foreign body aspiration in children with cough/wheezing that doesn't respond to nebulizers - also in patients with 'chronic cough' or 'recurrent pneumonia'
 - ▶ Stridor is the most suggestive exam finding of foreign body aspiration
 - ▶ Until the age of 15, the right and left main bronchi arise from the same angle from the trachea so **objects are aspirated into either the right or left lung with equal frequency**
 - ▶ Expiratory films and decubitus films are helpful
 - ◆ Mediastinum should shift toward dependent lung (side that is down)
 - ◆ If decubitus view looks the same as an upright view, this suggests air trapping and foreign body aspiration
 - ▶ *Normal plain films are not enough to rule out a foreign body*
 - ▶ If concern persists after a normal x-ray, consider CT. Bronchoscopy can provide a definitive diagnosis.

What do you see in these films of a child with suspected foreign body aspiration?



Left lateral decubitus



Right lateral decubitus

When the right side is placed down (second image), the right hemithorax remains inflated due to obstruction. The dependant side (side down) should normally take on an atelectatic or expiratory appearance. Therefore these films demonstrate air trapping on the right.

- Neonatal Pneumonia
 - ▶ Strep group B is most common
 - ▶ Major risk factor: preterm prolonged rupture of membranes

A 6 year old male presents with fever, cough, night sweats, and generalized malaise for three days. Chest x-ray is shown; which of the following is the most likely diagnosis?



- A) Tuberculosis
- B) Fungal infection
- C) Round pneumonia
- D) Abscess
- E) Aspergilloma

Answer: C

Explanation: Round pneumonia is typically only found in pediatric patients due to anatomic changes in the lungs. It is most often seen in the superior segments of the lower lobes and, as with other cases of pneumonia, *S. pneumoniae* is the most common cause. All of the other options are in the differential.

More pictures of round pneumonia:



Which of the following is the antibiotic of choice in a 6 year old child with pneumonia?

- A) Amoxicillin
- B) Doxycycline
- C) Azithromycin
- D) Levofloxacin

Answer: A

Explanation: High-dose amoxicillin is first-line treatment for children with uncomplicated community-acquired pneumonia. If patients fail treatment with amoxicillin, coverage for atypical organisms (Mycoplasma) is added on.

Doxycycline may cause tooth discoloration when used for greater than 14 days.

- **Bronchiolitis**

- ▶ Most cases are caused by RSV
- ▶ Clinical diagnosis: viral prodrome followed by wheezing, rales, and retractions in children < 2 years
- ▶ Non-severe bronchiolitis should be treated with supportive care only (oxygen, nasal suctioning, etc)
- ▶ Severe bronchiolitis (nasal flaring, retractions, grunting, tachypnea, hypoxia) usually require hospitalization. A one-time trial of bronchodilators may be warranted in such cases. Systemic glucocorticoids are not recommended.
- ▶ Repeated episodes during infancy may increase the risk of developing asthma later in life

- Croup

- ▶ Most common in children 6-36 months of age
- ▶ Associated with parainfluenza virus
- ▶ Symptoms: nasal congestion, hoarseness, barking cough, fever, stridor
- ▶ 'Steeple sign' on x-ray
- ▶ Treatment:
 - ◆ Beta agonists and dexamethasone
 - ★ Dexamethasone (0.6 mg/kg) by the least invasive route possible
 - ◆ Racemic epinephrine for patients with stridor at rest
 - ◆ Children who have received nebulized epi with good response should be observed for at least 3 hours (symptoms usually improve within 30 minutes but may return as the effects of epinephrine wear off)



Bacterial Tracheitis

What is it?

A rare life-threatening bacterial infection of the subglottic trachea, resulting in a thick/purulent exudate which causes symptoms of upper airway obstruction. It's almost exclusively seen in children.

How does someone get it?

When a child has a viral pharyngitis and picks up a **superinfection** on top of it, most often **S. aureus**

Besides recent history of a viral infection, how do patients present? With signs of airway obstruction: stridor, cough, and respiratory distress

Diagnosis?

X- Ray can show 'steeple sign' (same as croup)

Endoscopy is an important diagnostic and therapeutic component of management

(may be necessary to remove pseudomembranous exudates, which can cause airway obstruction)

Treatment is airway management, antibiotics, and endoscopy if needed

Which of the following is the least appropriate method of maintaining an

airway in a child with epiglottitis?

- A) Oral intubation
- B) Cricothyrotomy
- C) Supraglottic airway
- D) Fiberoptic intubation

Answer: C

Explanation: Supraglottic airways, such as LMAs, may further obstruct the airway by pushing the swollen epiglottis down over the laryngeal inlet.

- Epiglottitis
 - ▶ Symptoms/signs: severe upper airway obstruction (stridor, retractions, hoarseness)
 - ▶ Presentation: patients in tripod position having difficulty with secretions Classic finding: 'thumbprint sign' on lateral neck plain film
 - ▶ Treatment: **intubation in the OR first and then antibiotics**

Here's the question: which antibiotics? Use a third-generation cephalosporin (ceftriaxone or cefotaxime)



- Cystic Fibrosis
 - ▶ Patients develop recurrent bacterial pneumonias. *S. aureus* and *H. influenzae* are the most common causes of childhood pneumonia in CF patients, but *Pseudomonas* should also be considered.
 - ▶ CF is the number one cause of pediatric hemoptysis

- ▶ Patients are at higher risk for spontaneous pneumothorax

GASTROINTESTINAL

- Jaundice in the first 24 hours of life is pathologic. These patients are more likely to develop severe jaundice that could progress to kernicterus.

Physiologic jaundice – develops within the first week and lasts for up to two weeks vs

Pathologic jaundice – develops within the first 24 hours or persists > two weeks

- **Malrotation with Volvulus**
 - ▶ Most often seen in **first month of life** when the small bowel twists around the superior mesenteric artery resulting in vascular compromise to large portions of the midgut. This leads to ischemia and necrosis of the bowel that becomes irreversible.
 - ▶ Patients present with **bilious vomiting**, abdominal pain/distention, and bloody stool
 - ▶ Fluid losses and sepsis can rapidly progress; treat aggressively
 - ▶ “Double bubble” sign on x-ray + air fluid levels. Ultrasound or Upper GI contrast series are best diagnostic tests (not CT) – but use caution with giving contrast if concern for obstruction exists
 - ▶ Treatment: surgery

If bilious vomiting in an infant is malrotation until proven otherwise, what’s non- bilious vomiting in an infant?

Pyloric stenosis until proven otherwise. Like malrotation, which really isn’t seen past one month of age, pyloric stenosis isn’t seen very often past 3

months of age. So any child age 3 months or less that comes in for non-bilious projectile vomiting, consider pyloric stenosis. For test question purposes, if there is an olive-shaped palpable mass then there is no need for imaging – obtain immediate surgical consultation. However if the diagnosis is less certain and there is *no* palpable mass, an ultrasound should be obtained.

Pyloric stenosis: hypokalemic hypochloremic metabolic alkalosis

A 5 week old with **nonbilious emesis** who has **failure to thrive** most likely has **pyloric stenosis**

- **Intussusception:**

- ▶ Most common abdominal emergency in early childhood; typically **age 6- 36 months**. Children have intermittent crampy abdominal pain and draw their legs up to the abdomen with pain-free periods between episodes. You may feel a sausage-shaped abdominal mass in the right side of the abdomen.
- ▶ Stool can be hemoccult positive; mixture of blood and mucous = **currant jelly stool (late finding)**.
- ▶ ‘Double bubble’ sign can be seen on ultrasound
- ▶ **Treatment: air contrast or barium enema**
- ▶ Adult intussusception is rare and often due to cancer. Definitive treatment in adults is surgical resection.

*** Pyloric stenosis is classically associated with non-bilious vomiting. *But*, in an **infant with non- bilious emesis** the most likely cause of **acute abdomen** is **intussusception** ***



- **Duodenal Atresia**

- ▶ Congenital obstruction of duodenum associated with Down Syndrome and in pregnancies that are complicated by polyhydramnios
- ▶ “Double bubble” sign on x-ray
- ▶ Treatment: surgery



- **Hirschsprung's Disease**
 - ▶ Aka congenital aganglionic megacolon
 - ▶ Absence of ganglion cells in myenteric and submucosal plexuses of bowel
 - ▶ Most common in *rectosigmoid* area
 - ▶ Presenting symptoms include absence of stool in the rectal vault, abdominal distension, bilious emesis - AND
 - ◆ Newborns: failure to pass meconium
 - ◆ Children: chronic constipation
 - ▶ Diagnosis: rectal biopsy or rectal manometry
 - ▶ Treatment: surgery
- Necrotizing Enterocolitis
 - ▶ Seen primarily in premature infants during the neonatal period
 - ▶ Signs/symptoms include poor feeding, vomiting, abdominal distension, and guaiac positive stools
 - ▶ Pneumatosis intestinalis (air in bowel wall) on x-ray
 - ▶ Treatment: supportive care, antibiotics, may need surgery

Swallowed maternal blood can cause the false impression that a neonate is

having bloody stools. The Apt test can be used to make this distinction: enzymatic solution is added to the neonate's stool; if maternal blood is present it will turn brown whereas fetal blood will remain red. In a neonate with bloody stools, this is the first test to do.

- Meckel's Diverticulum
 - ▶ Painless rectal bleeding in an otherwise well-appearing infant
 - ▶ Rule of 2's: present in 2% of the population, only 2% ever develop symptoms, located within 2 feet proximal to the ileocecal valve, 2cm long and 2cm wide, and half of all patients develop symptoms by the age of 2
 - ▶ Painless bleeding that resolves spontaneously
 - ▶ Diagnosis: Meckel's scan
- Hemolytic-Uremic Syndrome
 - ▶ Major systemic complication of enterohemorrhagic E.coli (E.coli O157:H7)
 - ▶ Acute renal failure, hemolytic anemia, and thrombocytopenia
 - ◆ These symptoms begin 5-10 days after a diarrheal illness
 - ▶ Symptoms: abdominal pain, vomiting, bloody stools
 - ▶ If the patient has fever + CNS involvement in addition to the above, consider TTP-HUS (thrombotic thrombocytopenic purpura)
 - ▶ **Antibiotics may worsen outcomes**
- Don't use aspirin in children with viral illnesses as it can cause Reye's Syndrome! How will you know if a child has Reye's Syndrome? Look for rash, vomiting, cirrhosis, lethargy, encephalopathy, or death...

A 10 day old infant presents with swelling around his umbilicus that started today. There is a small amount of erythema and drainage but no fluctuance noted, and the child is afebrile. What is the best next step in management?



- A) Refer to PCP for cauterization
- B) Discharge home with reassurance and topical antibiotics
- C) Admit to the hospital for IV antibiotics
- D) Consult a pediatric surgeon for management
- E) Send labs and cultures and have the patient follow-up

Answer: D

Explanation: This child has omphalitis, which is a superficial cellulitis of the umbilical cord. Approximately 10% of cases will progress to necrotizing fasciitis so even the simplest case should involve consultation with a pediatric surgeon early. Simple cases typically respond to IV antibiotics within the first 24 hours; if there is no improvement surgery may be indicated. Many patients will not display signs of sepsis (tachycardia, tachypnea, and fever) until the superficial cellulitis has progressed to necrotizing fasciitis. In most cases of omphalitis, patients will not have a fever.

In the above patient, which of the following organisms is most likely to be seen on culture?

- A) *S. aureus*
- B) *Pseudomonas*
- C) *S. epidermidis*
- D) *C. albicans*
- E) Normal skin flora
- F) More than one bacteria

Answer: F

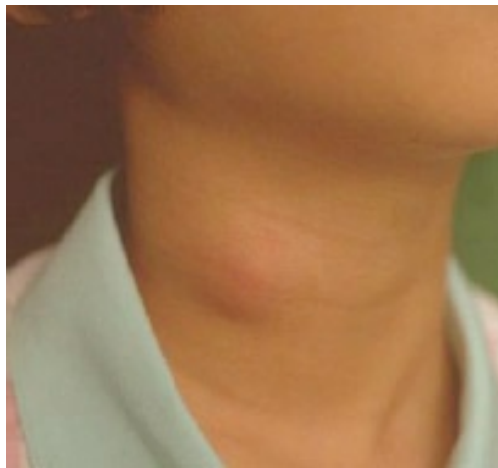
Explanation: Most cases of omphalitis are polymicrobial. Treatment generally includes antibiotics which are antistaphylococcal and antipseudomonal as well as clindamycin or metronidazole for anaerobic coverage.

Differentiate omphalitis from an umbilical granuloma! With granulomas, the umbilicus can appear raw [and draining] but there will be no erythema or other sign of infection. Treatment is outpatient follow-up and silver nitrate cauterization.



DERMATOLOGY

- Pediatric Burns
 - ▶ Compared to adults:
 - ◆ Thinner skin and less developed mechanisms of thermoregulation so they tend to get deeper burns
 - ◆ Higher overall fluid requirements
 - ◆ Lower incidence of inhalation injury but higher risk due to relative immobility and inability to escape closed spaces
 - ▶ Require as little as 15% total BSA to trigger a systemic response
 - ▶ Most common complication: infection
 - ◆ UTI due to prolonged foley catheter use is the most common source of infection in children < 16 years of age
- Another question that shows up on exams asks about a child under the age of five who develops a neck mass. The patient is typically well-appearing before this and the mass arises spontaneously. If there are signs of infection, consider an abscess. Otherwise the diagnosis is a *branchial cleft cyst* and management is outpatient removal by an ENT.



- Kawasaki Disease
 - ▶ The leading cause of acquired heart disease!
 - ▶ **Diagnosis:** fever > 5 days & at least 4 out of 5 of the following:
 - ◆ Conjunctivitis

- ◆ Rash
- ◆ Adenopathy (cervical)
- ◆ Strawberry tongue, fissured lips
- ◆ Hands and feet edema/erythema

What might happen if you don't make the diagnosis and start treatment?

Coronary artery aneurysm!

What if the child doesn't have 4 of the criteria? What if they only have 2??

Then they have 'incomplete Kawasaki disease' – either way, they're still at the same risk of developing **coronary artery aneurysm**

Treatment: IVIG + high-dose aspirin *started within 10 days of symptoms*

- Henoch-Schonlein Purpura
 - ▶ Abdominal pain, GI bleeding, hematuria, palpable purpura, arthritis
Immunologically-mediated vasculitis
 - ▶ Pathognomonic skin lesions: palpable round symmetrical areas in gravity-dependent areas like lower extremities and buttocks
 - ▶ Symptoms: colicky abdominal pain (**ileoileal intussusception**), bloody diarrhea, migratory polyarthritis, hematuria
 - ▶ Long-term prognosis is determined by the degree of *renal involvement*
 - ▶ Treatment: mostly supportive - NSAIDs, steroids in extreme cases
 - ▶ A much more serious disease when present in adults



- Mumps
 - ▶ Parotid swelling (can be unilateral or bilateral)
 - ▶ Epididymo-orchitis (can be unilateral or bilateral)
 - ▶ Lab tests are unnecessary if clinical suspicion is high
- Measles (aka rubeola)
 - ▶ Cough, coryza, conjunctivitis
 - ▶ Maculopapular rash begins on head and spreads downward
 - ▶ Koplik's spots are pathognomonic
 - ◆ Seen on buccal mucosa
 - ◆ 1-3 mm white/gray elevations on an erythematous base
 - ▶ Subacute sclerosing panencephalitis: Fatal progressive complication occurring 7-10 years after infection



- Roseola Infantum
 - ▶ 3-5 days of high fever that resolves and is followed by a rash
 - ▶ Human herpesvirus 6

Make sure to keep these straight: Rubeola causes a rash that starts on the head and spreads downward. Roseola causes fever that resolves and *then* onset of rash. Rubella is also known as '3-day measles' and is pretty benign unless we're talking about the neonatal form.

- Enterobius aka Pinworm

If a mother reports her child has been scratching his anus, pinworms are the first thing you should think about. The most sensitive test is the

‘scotch tape’ test, where you apply a piece of scotch tape to the child’s anus, pull it off, and look for worms. In the real world, any child that has an itchy anus will just get empirically treated. Enterobius is not shed in the stool so checking a culture for ova/parasites isn’t helpful. Treatment is a single dose of mebendazole or pyrantel. [All family members should be treated.](#)

NEUROLOGY

- Both cephalohematoma and caput succedaneum are more common with forceps or vacuum delivery and usually resolve spontaneously; no treatment needed
 - ▶ Cephalohematoma causes swelling that does not cross suture lines
 - ▶ Caput Succedaneum causes swelling that extends across suture lines
- Infantile Spasms
 - ▶ Epileptic spasms that start between 3-8 months of age (infant, duh)
 - ▶ Patients present with a jerking movement in which the body flexes or extends suddenly. Eventually, multiple clustered jerks develop.
 - ▶ Diagnosis: EEG will show hypsarrhythmia
 - ▶ Treatment: ACTH
 - ▶ Very poor prognosis; mortality rate is reported as high as 33%
- Febrile seizures
 - ▶ Convulsions that occur in a child between 6 months and 6 years of age
 - ▶ Family history is considered a risk factor
 - ▶ Simple febrile seizure
 - ◆ More common, last < 15 minutes, no associated weakness afterwards
 - ◆ Complex febrile seizure
 - ▶ Last > 15 minutes, children may have temporary weakness
 - ▶ Children are at higher risk to have another febrile seizure in the

future

◆ Risk factors for recurrent febrile seizure: younger age and lower temperature at time of first episode

- ▶ The risk of a child with simple febrile seizures developing epilepsy is 1% (about double the risk for the general public). The risk of a child with complex febrile seizures developing epilepsy is 6%.
- ▶ Neuroimaging and EEG are not routinely recommended
- ▶ The American Academy of Pediatrics says the following regarding lumbar puncture: “An LP should be strongly considered in all infants less than 12 months of age...infants on antibiotics at the time of the seizure should receive an LP.”

So if you were asked which patient with a febrile seizure needed a lumbar puncture, and were given options such as an unvaccinated child, a 3 year old with a fever of 105°F, or a 6 month old on antibiotics for otitis media: the answer is the 6 month old who has a febrile seizure while on antibiotics for otitis media.

Knowledge bomb! At what level should an LP be performed in an infant? In infants, the spinal cord ends at L3, so the needle should be inserted at L4-L5.

MISCELLANEOUS

A child falls while running with a popsicle stick in his mouth. Parents removed it and noticed a spot of blood at the roof of his mouth where it penetrated. Vital signs are normal and the child is in no distress. What is the next best step?

- A) Discharge home with return precautions
- B) Order plain films
- C) Request an ENT consultation
- D) Admit to the hospital overnight for observation

Answer: B

Explanation: Intra-oral injuries from penetrating objects can lead to some serious complications. Bleeding is often self-limited but the jugular and carotid arteries are nearby so persistent hemorrhage should be taken very seriously. Consider an angiogram if there is persistent bleeding or the presence of a hematoma. Remember that even though the injury may appear innocuous, objects can penetrate deeply. Secondary infection can develop hours to days later – specifically be concerned about the potential for retropharyngeal abscess. Empiric antibiotics, however, are not necessary for every case. Plain films of the neck should be ordered in almost every case as they may help identify foreign bodies and free air.

Pop Quiz! To reiterate some x-rays:

Parents bring in their child after noticing that two of their favorite magnets are missing.

The x-ray:



What should you do next?

The x-ray confirms that two magnets are present and have passed the

stomach. These need to be removed as they can attract each other across bowel wall leading to fistula, necrosis, or perforation. Even if you only saw one magnet on the x-ray, with this history the x-ray can be misleading and removal should be attempted.

Next up you have parents who have an extensive coin collection. They notice the 1913 Liberty Head nickel that's worth over \$4 million is missing. They look at their baby who grins back at them. You order an x-ray and here's what you see:



It's in the sagittal orientation so this is in the trachea right? Get it out stat! Not so fast...this is a lateral film showing the coin in sagittal orientation so of course the AP would look like this:



You can either attempt removal or just get weekly x-rays to make sure it's progressing appropriately. Then clean it off REALLY well before trying to sell the coin.

Finally, you have a child who was playing with needles and accidentally swallowed one. While your colleague contacts social services, you order an x-ray that looks unremarkable. What's next?

I guess they were wrong? Sounds like a pretty far-fetched story. Before you print off those discharge papers, any patient who potentially swallows a sharp pointed object needs endoscopic evaluation. Many objects are radiolucent and won't show up on x-ray, and letting these go risks perforation anywhere along the GI tract. Call GI, and then talk to DFCS.



A patient presents with new-onset psychosis. Which of the following findings suggests a medical etiology as opposed to an underlying psychiatric disorder?

- A) Adolescent age
- B) Visual hallucinations
- C) Gradual progression
- D) Flat affect

Answer: B

Explanation: Medical etiologies for psychosis are typically acute in onset and are more common in the elderly population. Patients are often disoriented, altered, aphasic, and/or ataxic. Visual hallucinations are associated with a medical etiology while auditory hallucinations are more in line with a psychiatric etiology.

Which of the following patients is at highest risk for successfully committing suicide?

- A) 25 year old woman
- B) 65 year old woman
- C) 70 year old male
- D) 15 year old male

Answer: C

Explanation: Elderly white males have the highest rate of completed suicide. Females attempt suicide more often while men are successful more often. A previous attempt is the number one risk factor. Presence of firearms in the home is another risk factor and firearms are the most common method of *completed* suicide. Hanging is the most common method of *attempted* suicide.

Two variants of suicide you should be aware of:

1. 'Silent suicide' = slowly killing oneself by non-violent means

(starvation)

2. 'Occult suicide' = self-destructive acts disguised as accidents

- Normal grief after death of a loved one can last *up to six months*
- **Borderline** Personality Disorder
 - ▶ Emotional lability, unstable relationships, impulsiveness, and self-destructive behavior with frequent suicidal threats/gestures
 - ▶ Imagine the patient who continues to threaten to commit suicide and comes to the hospital with superficial lacerations to their wrists
- **Narcissistic** Personality Disorder: exaggerated sense of self-importance
- **Histrionic** Personality Disorder: emotional, dramatic, attention-seeking, seductive
- **Antisocial** Personality Disorder: substance abuse and disrespect for the law

Which of the following is true regarding the positive and negative symptoms of schizophrenia?

- A) Paranoid delusions and anhedonia are positive symptoms
- B) Paranoid delusions and neologisms are positive symptoms
- C) Paranoid delusions and disorganized speech are negative symptoms
- D) Paranoid delusions and flat affect are negative symptoms

Answer: B

Explanation: Positive symptoms include delusions, hallucinations, and disorganized speech/behavior. Negative symptoms are flat affect and lack of speech. Negative symptoms are often refractory to treatment.

What is the best way to differentiate anorexia nervosa from bulimia?

Anorexic patients have extreme weight loss while bulimic patients have

normal or slightly decreased weight. Anorexia is found in adolescent females with a distorted body image while bulimia is characterized by impulsive bingeing and purging. Electrolyte abnormalities are common in both, so beware which medications you use. For instance, bupropion can lower seizure threshold and is best avoided.

Delirium	Dementia
Rapid onset	Slower onset
Fluctuates	Slowly progressive
Lasts hours-weeks	Lasts months-years
Sleep-wake disrupted	Sleep-wake normal mostly
Alertness impaired	Alertness normal
Disoriented	Disoriented late
Frequent visual hallucinations	
Most common cause in elderly: medications	Most common cause in elderly: Alzheimer's

- Parkinsonism – 4 features:
 - ▶ Difficulty with balance
 - ▶ Shuffling gait
 - ▶ Pill-rolling tremor
 - ▶ Cog-wheel rigidity

A first year emergency medicine intern has just finished his internal medicine rotation. He remembers being bitten by a scorpion several years ago and after taking care of several patients with pancreatitis he is now convinced that he has it. He has checked himself into the emergency room three separate times and has had negative blood tests, a negative CT scan, and three normal rectal exams. He presents again today asking for more tests, and possibly another two rectal exams. Which of the following might this intern have?

- A) Conversion disorder
- B) Munchausen syndrome
- C) Somatization disorder
- D) Depersonalization
- E) Hypochondriasis
- F) Malingering

A 40 year old female comes to the ER with abdominal pain. She had an exploratory laparotomy done one week ago that was unremarkable. Today she has a fever and the wound appears infected. One of the nurses notices her picking at the wound and putting her feces into it. Which of the following is the most likely diagnosis?

- A) Malingering
- B) Hypochondriasis
- C) Factitious disorder
- D) Depersonalization

Answer: E, C

Explanation: **Somatization disorder** is when a patient has physical complaints as a result of an underlying psychiatric condition.

Hypochondriasis is when one has a conviction that he or she is sick and pursues medical care; they are cooperative with all evaluations but have no secondary gain. **Conversion disorder** involves sudden onset neurologic complaints with no organic basis, usually in response to stressful events (for instance if a mother can no longer move her leg because her son had his amputated in an accident). This is typically involuntary and subconscious.

Malingers have an external incentive and are uncooperative with evaluation – it is a voluntary and conscious decision. Finally, patients with **Munchausen** syndrome create stories about a medical illness to have tests done; their symptoms are described as if they are right out of a textbook and their end goal is hospitalization. They are cooperative with all tests (for instance pricking their finger to falsify urine results in the hope of getting

another big workup). Munchausen is also known as ‘factitious disorder’.

What do I need to know about serotonin syndrome?

This is an important condition to be familiar with: if you don’t keep it in the back of your mind you *will* miss the diagnosis. And you won’t ever forget about it again. Patients can present with confusion, agitation, tachycardia, and fever. Symptoms range from tremor to clonus to rigidity and even **death**.

It can be seen with lots of medications that you might not even think of as having to do with serotonin:

- SSRIs (citalopram, paroxetine, etc)
- Analgesics (fentanyl, tramadol)
- Anti-emetics (ondansetron, metoclopramide)
- Migraines (triptans)
- Tricyclic antidepressants

Patients don’t have to overdose on any of these to get serotonin syndrome – they could be taking one for years, then one day have another of these meds added on and BOOM – SEROTONIN SYNDROME.

Treatment is to stop the medications and provide supportive care (ABCs...) Anti-pyretics should not be used to treat fever. Benzodiazepines can stop tremors/seizures. Cyproheptadine may be of benefit. Consider intubation/sedation/paralysis just to stop the muscle rigidity. Overall it’s a scary disease and the first time you see it you won’t forget it!

What about Neuroleptic Malignant Syndrome?

This is also potentially life-threatening but rather than too much serotonin activity there’s too little dopamine activity. Patients present with confusion, fever, muscular rigidity, etc. Sound familiar? It’s *very* similar to serotonin syndrome but there are some key differences: with NMS there is severe muscle rigidity and there are lab abnormalities: leukocytosis and increased CPK levels. While serotonin syndrome can occur within hours, NMS typically begins several days after the offending agents are started.

Serotonin Syndrome

Neuroleptic Malignant Syndrome (NMS)

Onset < 24 hours

Onset is days to weeks

Tremor/myoclonus

Severe muscle rigidity

Hyperreflexia

Slowing of reflexes

Normal labs

Increased CK levels

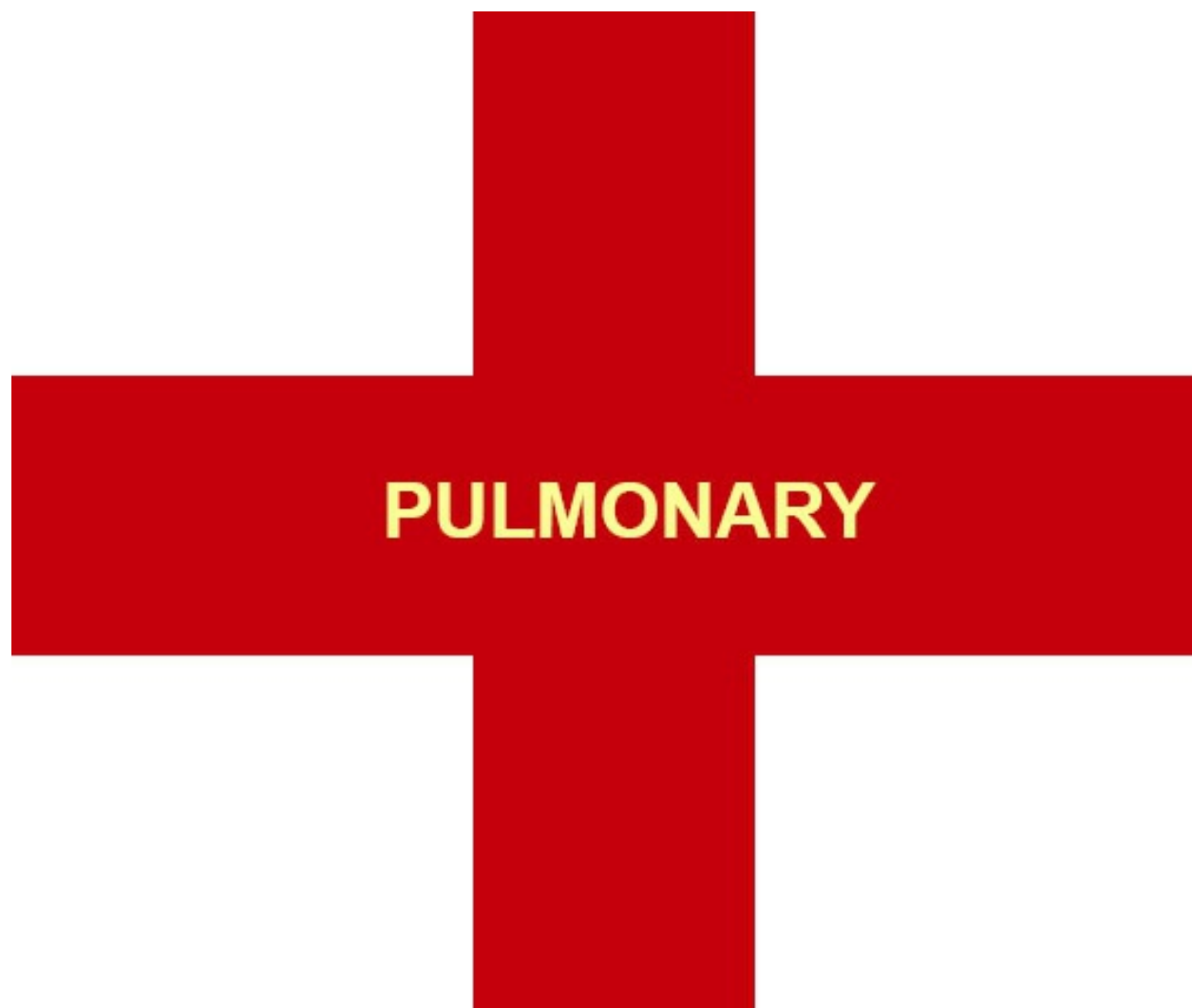
Treatment: stop the drugs!

Treatment: stop the drugs!

Cyproheptadine may be beneficial

Bromocriptine and dantrolene may be useful

- **Malignant Hyperthermia** also needs to be distinguished from serotonin syndrome and NMS. It's a rare autosomal dominant disorder that manifests when patients receive succinylcholine or some other type of inhaled anesthetic. Excess calcium gets released causing sustained contraction and heat production. Patients will present with sudden onset of difficulty ventilating due to chest wall rigidity. Treatment is with dantrolene (works by preventing release of calcium from the sarcoplasmic reticulum, thereby causing muscle relaxation).
- Akinesia : inability to initiate movement (severe Parkinsonism)
- Akathisia : a feeling of restlessness (tapping, pacing, rocking back and forth). This is reversible with benzodiazepines, benadryl, or benztropine. It is frequently associated with use of prochlorperazine (Compazine).
- Tardive dyskinesia : involuntary orofacial movements (lip smacking). It is frequently associated with prolonged use of antipsychotics.



- **Asthma**

- ▶ Reduced airway diameter due to **reversible** causes (bronchial constriction, edema, mucous plugging, etc)
- ▶ Decreased expiratory flow → air trapping
- ▶ Bedside spirometry (Wright peak flow): measures severity and response to treatment and predicts need for admission

What if you're treating a patient and the O2 saturation starts dropping?

An initial drop in O2 sat can occur once treatment is initiated

- ▶ Treatment: beta agonists are first-line therapy
- ▶ Treatment: steroids are just as effective when given PO compared to IV Treatment: magnesium acts as a smooth muscle relaxant and can have some benefit in severe exacerbations
- ▶ Intubation

There are some important things to keep in mind when intubating an asthmatic:

Ketamine is a bronchodilator which makes it a wonderful induction agent for asthmatic patients

PEEP is often not used due to intrinsic air trapping which generates auto-PEEP. Air trapping leads to increased intrathoracic pressures, decreased venous return, decreased cardiac output, and subsequent hypotension (therefore try to give a fluid bolus to patients before intubating). Patients can range from being asymptomatic to having a pneumothorax.

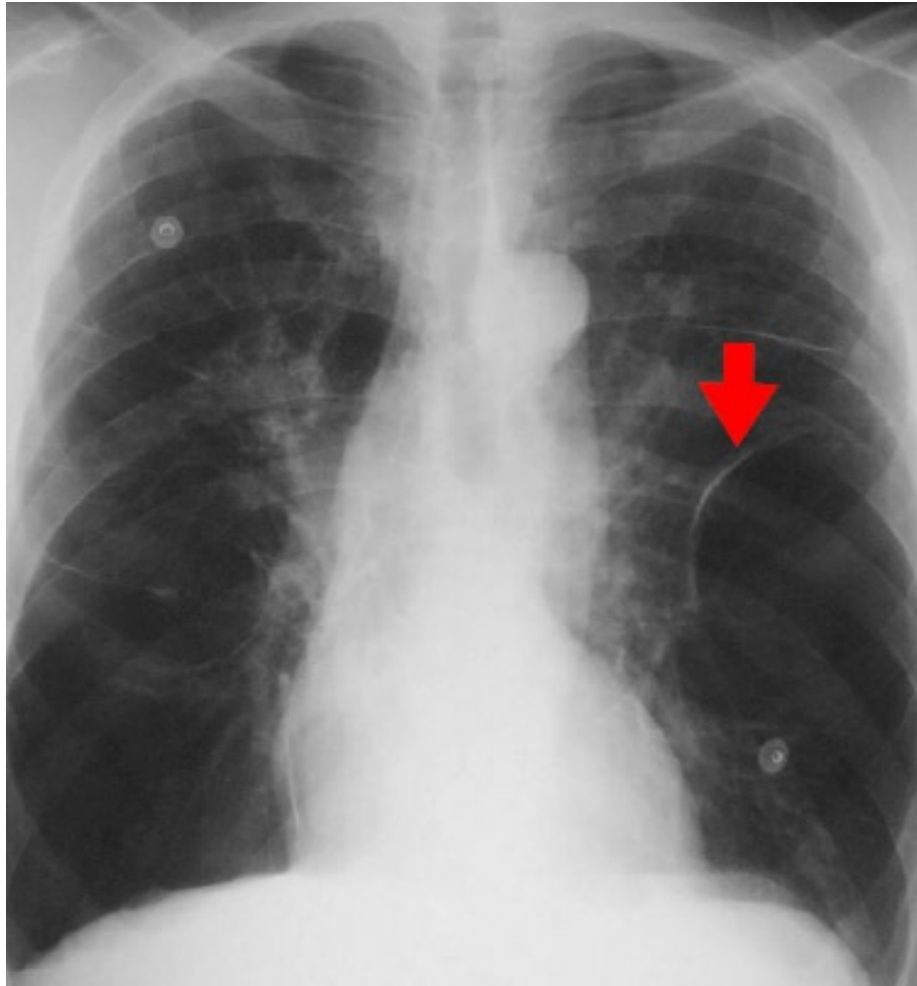
This correlates with elevated *plateau pressure* and can lead to barotrauma (*not peak airway pressure* – slight increases in peak airway pressure will NOT cause harm to a patient)

To prevent this, lower the plateau pressure (by lowering tidal volume or PEEP)

If an intubated asthmatic patient goes into cardiac arrest, **disconnect the**

ventilator, compress the chest by applying external pressure, place bilateral chest tubes, and give a fluid bolus

- **Exercise-Induced Asthma**
 - ▶ Peak symptom onset *5-10 minutes after exertion*
 - ▶ Cold-air athletes more likely to be affected than summer ones
 - ▶ Prophylactic beta-agonist therapy can prevent attacks
- Aspirin-Induced Asthma
 - ▶ Affects adult females more than any other demographic
 - ▶ Common precipitant of severe, life-threatening asthma
- **COPD**
 - ▶ As opposed to asthma, this is a chronic inflammatory disease: it is not fully reversible and less amenable to treatments such as magnesium.
 - ▶ There may be pulmonary blebs seen on x-ray, which can rupture and lead to pneumothorax



- ▶ A venous blood gas is fine when dealing with DKA, but studies have shown that the PCO_2 does not correlate as well when dealing with COPD: for this reason, ABG is preferred over VBG for patients with COPD.
- ▶ Don't over-oxygenate as this can impede the respiratory drive and lead to respiratory failure. Aim for a saturation between 88-92%.
- ▶ Steroids given orally are preferred over those given by IV (shorter hospital stays, no difference in mortality)
- ▶ Indications for antibiotics: a severe COPD exacerbation or any change in quantity or color of sputum
- ▶ Routine sputum cultures are not indicated
- ▶ Smoking cessation, home oxygen, and antibiotics have been shown to reduce mortality
- ▶ BIPAP (non-invasive ventilation) reduces morbidity, mortality,

length of stay, and need for intubation and should be used early if necessary

*If a patient has been intubated and has acute deterioration (bradycardia, hypoxia), think **DOPE**:*

- ▶ **D**islodgement of tube
- ▶ **O**bstuction from secretions (if there is resistance to bagging)
- ▶ **P**neumothorax
- ▶ **E**quipment failure

A person just got over a viral upper respiratory infection one week ago. Now they have productive cough and fever. X-ray shows an infiltrate. Which bacteria is likely responsible?

Well if you don't know, you *do* know that *S. pneumo* is the most common cause of pneumonia so it's a safe bet right?

WRONG!

Post-viral pneumonia think *S. aureus*!

Let's try it again: lobar pneumonia in an alcoholic patient who's coughing up currant jelly sputum (how many buzzwords was that in one question?). Okay, so we all know we're discussing *Klebsiella* – but which lobe of the lungs is most often affected?

If you said "RUL" then you "RUL..e!"

To summarize: *Klebsiella* pneumonia is often found in alcoholics and diabetics and manifests as a lobar pneumonia in the right upper lobe.

Mycoplasma pneumonia is what is typically referred to as 'walking pneumonia' and x-ray will show patchy interstitial changes.

What if a patient presents with productive cough, fever, a heart rate of 55, and nausea – which organism is likely responsible?

- A) Mycoplasma
- B) Chlamydia
- C) Legionella
- D) S. pneumoniae

Answer: C

Explanation: Legionella pneumonia is associated with water sources and air conditioning units. Patients can have altered mental status, bradycardia, nausea/vomiting/diarrhea, hyponatremia, and abnormal LFTs. Any time you see a patient with **GI symptoms + pneumonia: think legionella**. Then get real close to them because there is no person to person transmission.

Chlamydia can cause pneumonia, but it's very atypical: nonproductive cough and lack of fever. Buzzwords include: dry staccato cough, conjunctivitis, nasal congestion without much discharge. X-ray will show patchy interstitial changes and treatment for either chlamydia pneumonia or conjunctivitis is 14 days of oral erythromycin.

Which of the following is the most appropriate option for outpatient treatment of community-acquired pneumonia?

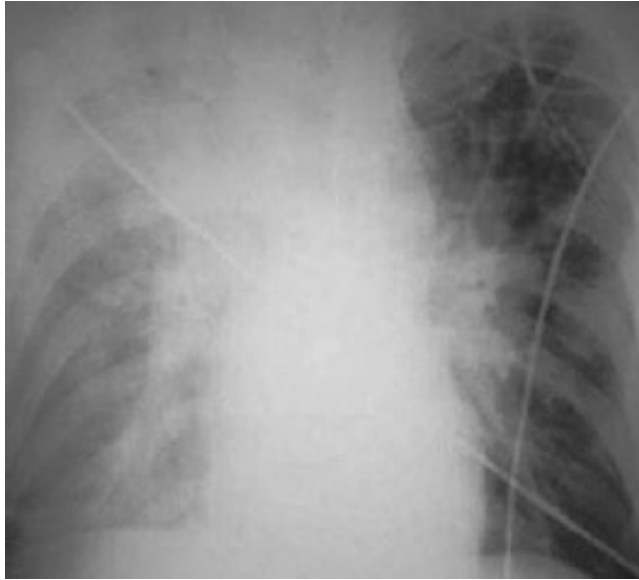
- A) Azithromycin
- B) Levofloxacin
- C) Clindamycin
- D) Trimethoprim/sulfamethoxazole (Bactrim)
- E) Ceftriaxone

Answer: A

Explanation: Outpatient treatment can include azithromycin, doxycycline, or amoxicillin amongst others. Inpatient treatment for community-acquired pneumonia consists of either a fluoroquinolone alone or the combination of azithromycin + ceftriaxone (azithromycin is given to cover for Mycoplasma, Chlamydia, and Legionella).

- **Anthrax**

- ▶ CDC: There is no person-to-person transmission of anthrax
- ▶ 3 forms: pulmonary, cutaneous, and GI – the most common form is cutaneous
 - ◆ Small painless papule that quickly enlarges and develops a central vesicle - followed by necrotic ulcer with a black eschar
- ▶ X-ray: prominent mediastinum and hilar lymphadenopathy



- ▶ Treatment: doxycycline
 - ▶ On a similar note, Hantavirus (think: rodents) is not contagious. Tularemia (think: rabbits) is highly contagious.
- **P. carinii pneumonia**
 - ◆ Most common *opportunistic* infection in HIV patients and now known as P. jirovecii pneumonia (regardless of CD4 count, S. pneumo is the most common cause of pneumonia in HIV patients)
 - ◆ Labs may show increased LDH (sensitive, not specific)
 - ◆ X-ray: bilateral interstitial infiltrates ('bat-wing' infiltrates)
 - ◆ Treatment: Trimethoprim/sulfa; if allergic to sulfa, pentamidine for inpatient treatment (can only be given IV or by inhalation) or primaquine/clindamycin for outpatient

Consider checking an ABG; indications for steroids in PCP:

$\text{PaO}_2 < 70$

A-a gradient > 35

- **Aspiration Pneumonia**

- ▶ Severity depends upon:

- ◆ Volume of aspirate

- ◆ pH of aspirate (more acidic is worse)

- ◆ Food particles

- ◆ Bacterial contamination

- ▶ Initial chest x-ray is often negative

- ▶ If aspiration occurs in the **supine position**, the **posterior segments of the upper lobes and superior segments of the lower lobes** are most commonly affected. In the **standing position**, the **right lower lobe** is most commonly affected but patients can have **bilateral infiltrates**.

Which organism is responsible?

Just like other types of pneumonia, community-acquired aspiration is typically *S. pneumoniae* and hospital-acquired aspiration should raise concern for *Pseudomonas*. Anaerobes are common in alcoholics and those with poor dentition.

Should you start antibiotics on every patient who aspirates?

The two main types of aspiration are chemical and bacterial – because it can be difficult to distinguish between the two initially, if patients are severely ill then start empiric antibiotics. Most cases do not require empiric antibiotics.

If needed, which ones?

Fluoroquinolones or piperacillin/tazobactam

Anything we should know to specifically *not* use?

Using metronidazole as monotherapy has high failure rates

Acute Respiratory Distress Syndrome (ARDS)

Think of it as a ‘non-cardiogenic pulmonary edema’

Diagnostic criteria:

- Acute onset
- Hypoxia
- PCWP < 18 (ie normal ventricular function ie noncardiogenic)
- Diffuse bilateral infiltrates/edema

All of the above seem like reasonable questions about ARDS...but what do test writers ask: What is the mortality rate of ARDS patients? (!) The answer: 40%.

Update! Test writers may have found a new question to ask: any special ventilator settings?

The answer: use low tidal volumes and low airway plateau pressures

Speaking of sepsis, which of the following is *not* a criteria for septic shock?

- A) Initial presenting systolic blood pressure < 90
- B) Heart rate 95
- C) WBC 13,000
- D) Temperature of 100.6°F
- E) Respiratory rate 22

Answer: A

Explanation: There are four criteria for systemic inflammatory response syndrome (SIRS) - patients must meet at least two of these. They are:

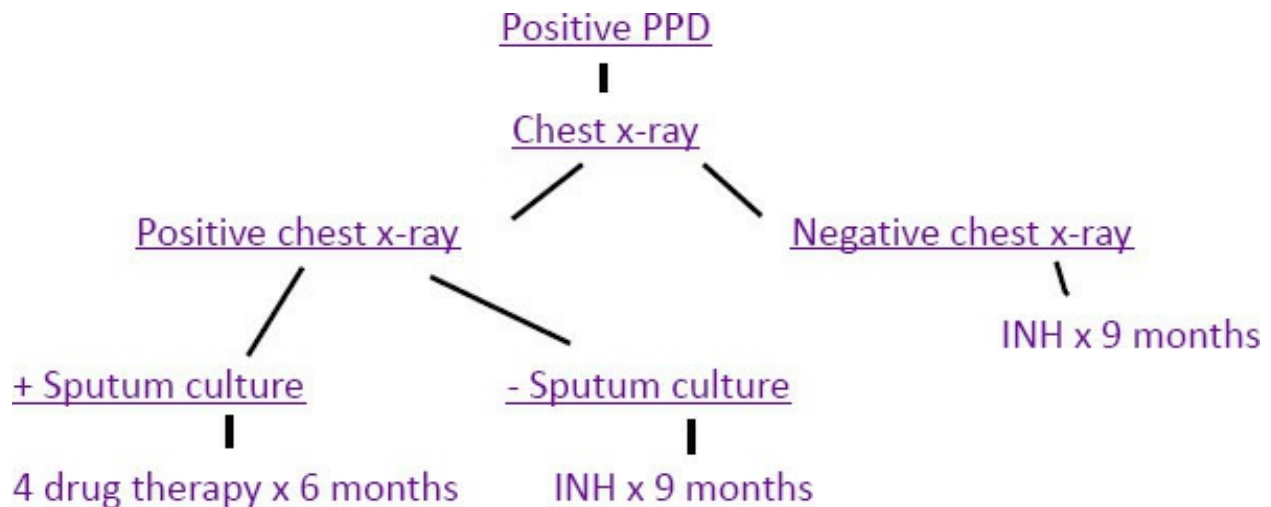
- Temperature > 38°C (100.4°F) or < 36°C
- Heart rate > 90
- Respiratory rate > 20
- WBC > 12,000 or < 4,000

Sepsis is defined as SIRS (ie 2 of the above) + a source of infection
Severe sepsis is defined as sepsis + lactic acidosis or BP < 90

Septic shock is defined as severe sepsis + hypotension despite IV fluid resuscitation or evidence of end-organ damage

- **Pertussis/Whooping Cough**
 - ▶ Three stages of disease

- ◆ Catarrhal phase: nonspecific URI symptoms x 1-2 weeks
 - ◆ Paroxysmal phase: paroxysmal cough that can last up to 1 month
 - ◆ Convalescent phase: chronic intermittent cough lasting months
- ▶ Cultures are useful only in the catarrhal phase
- ▶ Treatment:
 - ◆ Most cases improve after 3-4 weeks without antibiotics
 - ◆ Macrolides are given to reduce the high rate of infectivity, not to reduce the duration of symptoms. They *should be given to all household members and close contacts.*
- **Influenza**
 - ▶ Antiviral therapy should ideally be started within 48 hours to be effective, but in high-risk populations may have benefit even outside of this time period
 - ▶ First-line treatment: neuraminidase inhibitors (oseltamavir, zanamavir)
 - ◆ Oseltamavir is orally administered, Zanamavir is inhaled (contraindicated in asthmatics)
 - ▶ Rimantadine and amantadine are other options but are only effective against Influenza A
- **Tuberculosis**
 - ▶ What is considered a 'positive PPD'?
 - ◆ > 5mm: HIV, organ transplant, close contact/known exposure to TB patient
 - ◆ > 10mm: healthcare workers, diabetics, IV drug users, immigrants
 - ◆ > 15mm: no known risk for TB



- ▶ Reactivation TB: apical posterior lung lobes are most frequently involved Miliary
- ▶ TB: hematogenous dissemination
- ▶ Treatment side effects:
 - ◆ **INH** – peripheral neuropathy and hepatitis (**I**njures **N**eurons and **H**epatocytes)
 - ◆ Ethambutol – optic neuritis Streptomycin – ototoxicity, nephrotoxicity
 - ◆ Rifampin – discolored body fluids (reddish/orange), hepatitis
- Extra-pulmonary TB
 - ▶ **Most common site: lymph nodes** (painless cervical lymphadenopathy)
 - ▶ Most common neurologic TB disease: tuberculous meningitis
Skeletal TB most commonly involves the spine (Pott's disease)
- **Sarcoidosis**
 - ▶ Multi-system granulomatous disease with non-caseating granulomas in involved organs
 - ▶ **Non-infectious**
 - ▶ Chest x-ray: bilateral hilar adenopathy, pulmonary infiltrates
 - ▶ Staging is based upon chest x-ray Most common extra-pulmonary site: skin
 - ▶ Labs: hypercalcemia, **high ACE level**, anemia Treatment: steroids

- Anterior Mediastinal Mass
 - ▶ Anterior mediastinum is the space between the sternum and the pericardium
 - ▶ Causes include:
 - ◆ Thymoma (myasthenia gravis)
 - ◆ Thyroid Teratoma
 - ◆ T-cell lymphoma
 - ◆ Terrible (bronchogenic carcinoma = most common mediastinal mass)

- **Massive Hemoptysis**
 - ▶ By definition, > 600mL in 24 hours is considered 'massive hemoptysis'
 - ▶ Most common cause of massive hemoptysis worldwide is tuberculosis; in the United States it is bronchitis
 - ▶ Control the bleeding early and reverse any potential coagulopathy
 - ▶ Airway: determine which lung is bleeding and place the patient with that side down. If bleeding and oxygenation cannot be managed with suction and positioning, main-stem intubate the unaffected lung with a large-bore ET tube (size 8) if possible to allow for bronchoscopy

After performing a thoracentesis for a pleural effusion, which of the following lab findings is most suggestive of a transudate?

- A) Pleural LDH > 200
- B) Pleural protein > 3 grams
- C) Low pleural fluid protein : serum protein ratio
- D) Presence of cloudy or bloody fluid

Answer: C

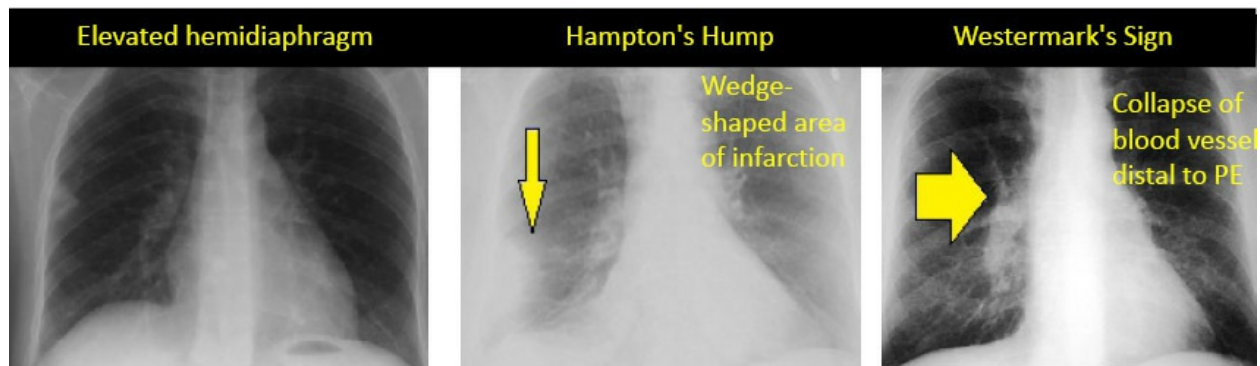
Explanation: Pleural effusions are best visualized on a lateral chest x-ray with the affected side down. Effusions can be transudative or exudative.

Transudates are typically clear with low protein levels and low LDH levels. Causes include CHF, cirrhosis, and nephrosis. Exudates are characterized by

high levels of LDH and protein, and are typically cloudy or bloody in appearance.

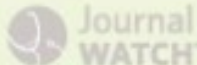
- **Pulmonary Embolism**

- ▶ Most common source: proximal leg DVT or pelvic vein thromboses
- ▶ **Most common EKG finding:** sinus tachycardia
 - ◆ Other associated EKG findings include RBBB, right axis deviation, S1Q3T3 (all signs of right heart strain)
- ▶ **Most common x-ray finding:** pleural effusion
- ▶ **Thrombolytics are indicated for massive PE (acute PE with sustained hypotension)**, and are of questionable benefit in submassive PE (acute PE without hypotension but with RV dysfunction). Bottom line: if a patient is unstable or has a saddle embolus, obtain a stat echo to help decide.

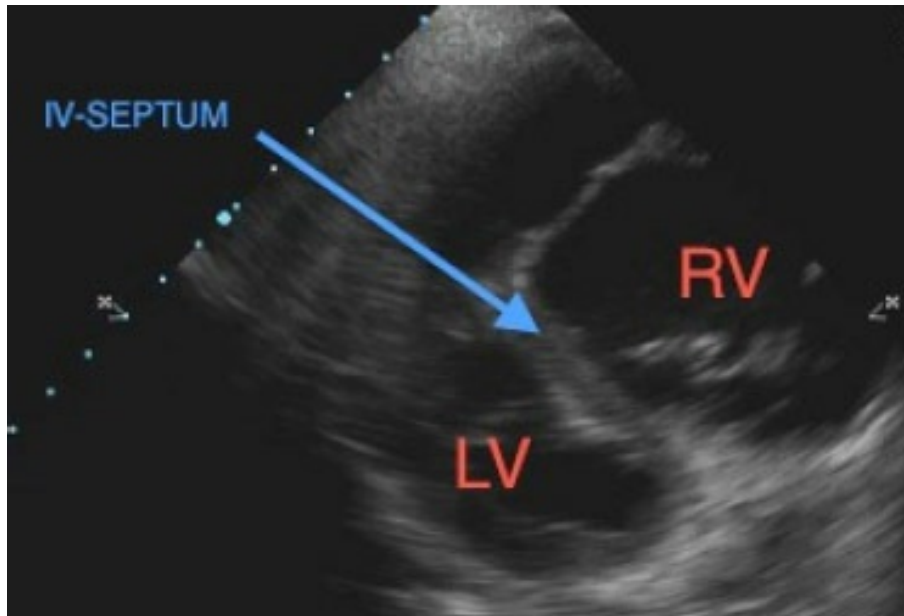


If there is *low pre-test probability* for PE and the PERC test is negative, no further tests are needed. If PERC positive, send a d-dimer. Wells' score also risk stratifies and helps provide pre-test probability in patients suspected of having PE. If both PERC and Wells' are negative, no further tests are needed.

Criteria	Points	
Clinical signs/symptoms of DVT	3	
PE is most likely diagnosis	3	
Tachycardia (>100 bpm)	1.5	
Immobilization/surgery in previous 4 weeks	1.5	
Prior DVT/PE	1.5	
Hemoptysis	1	
Active malignancy (trt w/in 6 month)	1	
Low Risk < 2 points	Intermediate risk 2-6 points	High risk >6 points

Pulmonary Embolism Rule-Out Criteria	
Variable	
Age <50 years	
Pulse <100 beats per minute	
SaO ₂ ≥95% on room air	
No hemoptysis	
No exogenous estrogen use	
No prior venous thromboembolism	
No surgery or trauma requiring hospitalization within the past 4 weeks	
No unilateral leg swelling	
	

ABEM's exams now include short clips of ultrasounds – one important one that you should be familiar with is identifying, based on an ultrasound, if a patient should or should not receive thrombolytics. I highly suggest you view some online videos to get a better idea of how right ventricular strain looks on an ultrasound:



The left ventricle is being forced inward by pressure built up inside the right ventricle – this is also known as the classic “D sign”

Pulmonary hypertension (PHT) is another condition to be familiar with. By definition, the mean pulmonary artery pressure is > 25 mmHg at rest or > 30 with exercise. These pressures should be measured by **right heart catheterization (gold standard for diagnosis)**. Primary PHT is relatively rare; secondary PHT is typically due to a cardiac or respiratory cause (valvular abnormalities, COPD, etc). In general there is no cure. **The key to treatment is to maintain adequate right ventricular filling pressure.** Therefore the initial focus is on administering IV fluids. Epoprostenol is considered first-line treatment in patients with severe disease. However, short-term infusion of epoprostenol *can* cause pulmonary edema, so this decision should be made only after discussion with a cardiologist.

What's the deal with A-a gradients?

What it is: the difference between the alveolar and the arterial concentration of oxygen. In other words, it's a measure of how well the lungs are transferring oxygen to your blood.

The gradient should be small (normal < 10 , others say 'age + 4 / 4') Either way, if the A-a gradient is > 20 it's abnormal!

Is there a quick and easy way to check this?

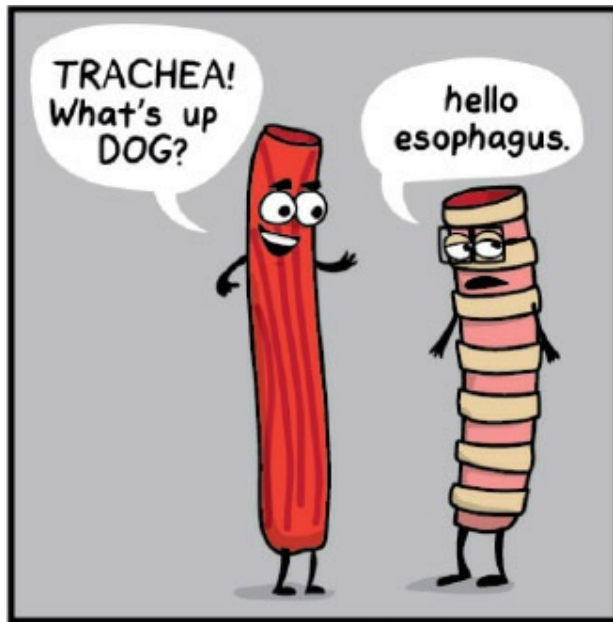
$$\text{A-a gradient} = [150 - (1.25 \times \text{pCO}_2)] - \text{pO}_2$$

As long as we're on the subject of equations, let's review Winter's equation:
In patients with a metabolic acidosis, the expected pCO₂ on an ABG is $(1.5 \times \text{HCO}_3) + 8 \pm 2$

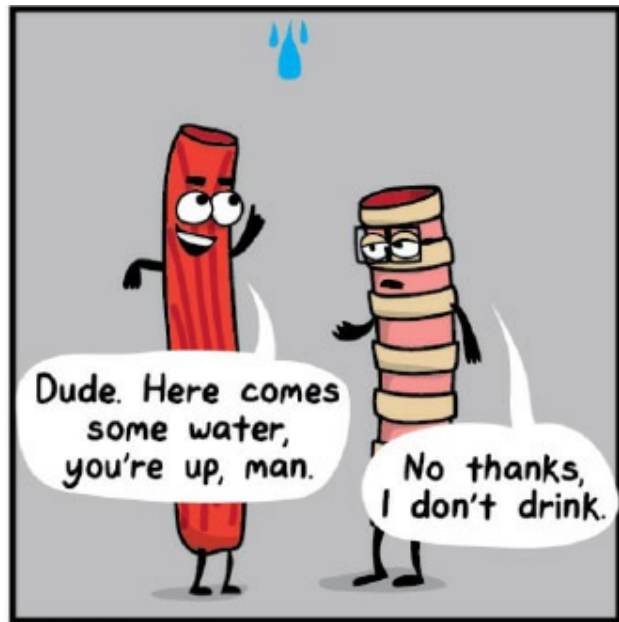
If the measured pCO₂ is > the expected, the patient also has a respiratory acidosis
If the measured pCO₂ is < the expected, the patient also has a respiratory alkalosis

And finally, in an acute respiratory acidosis/alkalosis, what is the expected HCO₃ and pH?

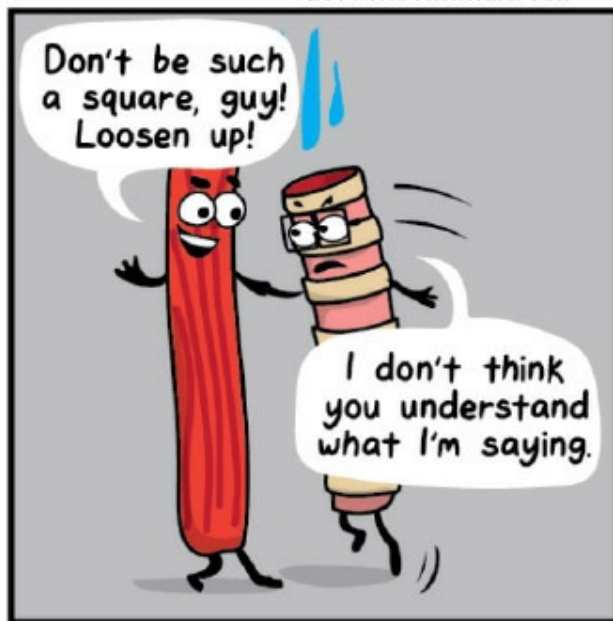
For every 10mmHg change in PCO₂, the pH changes 0.08 and HCO₃ changes 1-2



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TOXICOLOGY

DRUG ELIMINATION

- Most patients don't benefit from gastric decontamination for a variety of reasons
 - ▶ Ingestion of nontoxic substances
 - ▶ Ingestion of a nontoxic amount of toxic substances
 - ▶ They wait too long to present

How long is too long? Patients who present within one hour benefit the most from gastric decontamination

- **Syrup of Ipecac**
 - ▶ Induces vomiting within 20 minutes of ingestion
 - ▶ *No longer recommended* by the American Academy of Pediatrics
- **Gastric Lavage**
 - ▶ OG tube placed and repeated instillation/aspiration of fluid
 - ▶ Aka 'stomach pumping'
 - ▶ Absolutely contraindicated in cases of hydrocarbon ingestion and caustic ingestion and almost never recommended anymore
- **Activated Charcoal (AC)**
 - ▶ Greatest benefit when given within one hour
 - ▶ Contraindications:
 - ◆ Decreased level of consciousness
 - ◆ Hydrocarbon/caustic ingestion
 - ◆ Metal or otherwise poorly absorbed ingestion
 - ◆ Bowel obstruction
 - ▶ Can be given with sorbitol
- **Multi-dose Activated Charcoal**
 - ▶ Indications:
 - ◆ Tegretol
 - ◆ phenytoin
 - ◆ barbiturates

- ◆ Theophylline
- ◆ TCAs
- ▶ Concurrent use of a cathartic (sorbitol) is not recommended
- ▶ There is no evidence that multi-dose charcoal reduces morbidity or mortality but it can still be used in certain situations
- **Whole Bowel Irrigation**
 - ▶ Polyethylene glycol given to flush out the GI system by inducing diarrhea
 - ▶ Can be used for ingestion of sustained release products, ingestion of substances poorly bound to charcoal, or with ingestion of drug packets

What's the difference between a cocaine 'body packer' and a 'body stuffer'?

Body packers swallow small containers with highly concentrated amounts of cocaine – if one ruptures the packer can die. Body stuffers on the other hand tend to swallow the drug while being chased – they are trying to conceal evidence and rarely have any serious consequences to their health.

What are the indications for imaging in cases of overdose?

The following are radio-opaque and will therefore be seen on KUB/plain film (CHIPES):

Chloral hydrate

Heavy metals

Iron

Potassium

Enteric coated tabs

Slow-release forms

- **Urinary Alkalinization**
 - ▶ Most effective method (short of dialysis) to eliminate salicylates
 - ▶ Aim for a urine pH > 7.5 without raising serum pH too high
 - ▶ Sodium bicarbonate infusion most effective; do not use acetazolamide as it raises urine pH by lowering systemic pH and leads to other problems
- Contraindications:

- ◆ Renal failure, pulmonary edema, cerebral edema
- ◆ Other cases of volume overload
- **Hemodialysis**
 - ▶ Which ingestions/overdoses can be dialyzed: **I-STUMBLED**
 - ◆ Isopropyl alcohol, Iron, INH
 - ◆ Salicylates
 - ◆ Theophylline
 - ◆ Uremia
 - ◆ Methanol (if fomepizole ineffective)
 - ◆ Barbiturates
 - ◆ Lithium
 - ◆ Ethanol/ethylene glycol (if fomepizole ineffective)
 - ◆ Depakote (valproic acid)

ANTIDOTES

Agent	Antidote
Acetaminophen	N-acetylcysteine
Anticholinergics	Physostigmine
Aspirin	Alkaline diuresis, hemodialysis
Beta blocker	Glucagon
Barbiturate	Alkaline diuresis, hemodialysis
Benzodiazepines	Flumazenil
Calcium channel blocker	Calcium
Carbon monoxide	Oxygen, HBO
Cyanide	Hydroxocobalamin, sodium thiosulfate (best), amyl nitrite, sodium nitrite, sodium thiosulfate

	(alternate)
Digitalis	Digi-bind antibodies
Ethanol	Fomepizole
Ethylene glycol	Ethanol, fomepizole, dialysis
Heparin	Protamine sulfate
Hydrofluoric acid	Calcium gluconate
Iron	Deferoxamine
Isoniazid	Pyridoxine (vitamin B6)
Lead	Succimer, EDTA
Mercury	DMSA
Methemoglobinemia	Methylene blue
Methanol	Ethanol, fomepizole, dialysis
Opioids	Naloxone
Organophosphates	Atropine, 2-PAM
Tricyclic antidepressants	Sodium bicarbonate
Warfarin	PCC + vitamin K, FFP

TOXIDROMES

- **Anticholinergic**
 - ▶ Can be caused by antihistamines, antipsychotics, or antidepressants
 - ▶ ‘Blind as a bat, mad as a hatter, red as a beet, dry as a bone, hot as Hades’
 - ▶ Symptoms: blurry vision, delirium, flushed skin, dry skin, hyperthermia Others: mydriasis, hypoactive bowel sounds, urinary

- retention
- ▶ Treat confusion with benzodiazepines (avoid haloperidol)
- ▶ **Treat wide QRS complex with sodium bicarbonate**
- ▶ Consider physostigmine if benzos not working or in cases of refractory seizures, dysrhythmias, hyperthermia
 - ◆ Contraindicated in cases of heart block and TCA overdose
- **Cholinergic**
 - ▶ Can be caused by organophosphates (insecticides)
 - ▶ DUMBELLS: **D**iaphoresis, **U**rination, **M**iosis, **B**radycardia, **E**mesis, **L**acrimation, **L**ethargy, **S**alivation
 - ▶ Antidote: atropine until secretions are dry, 2-PAM
- **Sympathomimetic**
 - ▶ Caused most often by cocaine, amphetamines, caffeine
 - ▶ Symptoms: HTN, hyperthermia, tachycardia, tachypnea, mydriasis, diaphoresis
- **Opioid**
 - ▶ Symptoms: respiratory depression, miosis, hypotension, coma
 - ▶ Clonidine can mimic opioid overdose
 - ▶ Antidote: naloxone

SPECIFIC POISONINGS

- **Acetaminophen**
 - ▶ **Toxic dose: single ingestion > 150mg/kg in a child or > 7.5g in an adult**
 - ▶ Mechanism: glucuronidation and sulfonation pathways become saturated, metabolism shifts to CYP450 which uses up glutathione and allows toxic metabolites to accumulate

- ▶ Predisposing factors to injury:
 - ◆ Chronic alcohol ingestion, malnutrition, older age

Knowing the four stages of injury is important:

- Stage 1 – nausea/vomiting
- Stage 2 – GI symptoms resolve, hepatic/renal dysfunction begins
- Stage 3 – LFTs peak, renal failure, encephalopathy, sepsis, **death**
- Stage 4 – recovery phase if stage 3 is survived

If someone walked into the ER and told you they just took an entire bottle of acetaminophen, you have two options: you could wait for four hours and check a level, or, knowing this is a toxic dose, you could start N-acetylcysteine (NAC). Meaning?

1. *Checking a level prior to four hours is not very helpful*
2. You don't need a level to start treatment

Treatment with NAC is *equally* effective if started at 1 hr post-ingestion or at 7 hrs post-ingestion, as long as it's started within the first 8 hrs

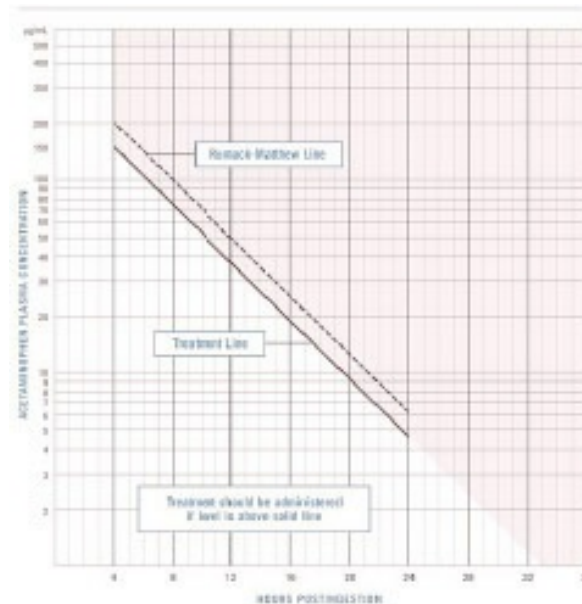
NAC provides a glutathione-like substrate which binds toxic metabolites and can be given orally or IV. Oral NAC is safe but can induce vomiting. If a patient vomits within one hour of being given NAC, the dose has to be repeated. If they start drinking it and haven't completed it by 8 hrs post-ingestion, the window may be lost. Further, if there is already evidence of liver failure, only IV NAC will be beneficial. However, the IV form has a higher incidence of anaphylactoid reactions. Most of these are benign and can be treated with benadryl/epi. When giving NAC IV, do not stop the infusion unless a life-threatening reaction occurs (unresolving bronchospasm for instance).

Okay, so what if a patient presents after, say, 16 hours of overdosing?

In the right setting, NAC is still indicated even if presentation is > 24 hours post-ingestion

Indications for NAC:

- ★ Level above the nomogram line following an acute ingestion
- ★ Suspected single ingestion $> 150\text{mg/kg}$
- ★ Unknown time of ingestion and level > 10
- ★ Patient with history of acetaminophen ingestion and evidence of liver injury



ALCOHOL WITHDRAWAL

6-12 hours Minor symptoms: anxiety, nausea, diaphoresis, 'shakes'

12-24 hours Hallucinations (visual, auditory, tactile)

24-48 hours Withdrawal seizures

48-72 hours Delirium tremens

- Delirium Tremens typically occurs after more than 48 hours of alcohol withdrawal and the hallmark finding is **disorientation**. Patients can also have hallucinations, hyperthermia, and tachycardia; mortality rate is around 5%.
 - ▶ Treatment for withdrawal: benzodiazepines
 - ▶ Disulfiram (antabuse) causes sweating, headache, flushing, palpitations when alcohol is consumed – used to treat alcohol

dependence

- ◆ Similar reaction occurs in patients who take metronidazole and consume alcohol
- ▶ Naltrexone blocks alcohol-induced dopamine release and is also effective in reducing alcohol craving, use, and relapse

For the next three ingestions, you should know how to calculate an osmolal gap. In fact, this may be the only clue you have to suspect an isopropyl alcohol ingestion! (at least methanol and ethylene glycol will produce an anion gap)

Osmolal gap = measured osmolality – calculated osmolality

Measured osmolality is a routine part of all BMPs - the result will be given to you. Calculated osmolality = $(2 \times \text{Na}) + (\text{BUN} / 3) + (\text{EtOH} / 5) + (\text{glucose} / 18)$

If the osmolal gap is > 10 then you should be concerned about the presence of another chemical (eg ethylene glycol, isopropyl alcohol, mannitol, etc)

- **Methanol**

- ▶ Found in paint thinners and window washing fluid
- ▶ Metabolized to formic acid
- ▶ Anion gap acidosis + increased osmolal gap
- ▶ **Blindness** from optic disc hyperemia
- ▶ Treatment: ethanol, fomepizole, dialysis if necessary

- **Ethylene Glycol**

- ▶ Found in antifreeze
- ▶ Metabolized to oxalic acid
- ▶ Anion gap acidosis + increased osmolal gap
- ▶ **Calcium oxalate crystals**, hypocalcemia, renal failure Treatment: ethanol, fomepizole, dialysis if necessary

- **Isopropyl Alcohol**

- ▶ Found in rubbing alcohol
- ▶ Metabolized to acetone

- ▶ **Normal anion gap** + increased osmolal gap
- ▶ **Hemorrhagic gastritis**, hypotension, hypoglycemia Treatment: supportive care, dialysis if necessary
- **Arsenic**
 - ▶ Found in wood preservatives, weed killers, and pesticides
 - ▶ Associated with mees lines, peripheral neuropathy, anemia, alopecia
Diagnosis: 24 hour urine
 - ▶ Treatment: chelation (DMSA, BAL)
- **Beta Blockers**
 - ▶ Symptomatic bradycardia and hypotension are the classic symptoms
 - ▶ High-dose glucagon is considered the first-line treatment
 - ▶ Other treatments include high dose insulin + glucose. Consider intra-lipid fat/emulsion therapy if treatment is refractive.
 - ▶ Two beta blockers that have unique treatment:
 - ◆ Propranolol causes sodium channel blockade leading to QRS widening – use sodium bicarbonate
 - ◆ Sotalol causes prolonged QT – monitor for torsades

If you are asked anything about beta blocker toxicity, it's likely to be about the treatment
- **Calcium Channel Blockers**
 - ▶ Verapamil and diltiazem are considered the most dangerous
 - ▶ As opposed to beta blocker overdose, *hyperglycemia* may occur
Calcium is considered the first-line treatment
 - ▶ Atropine may be given but it is typically ineffective. Again, high dose insulin + glucose should be used; consider pacing and intra-lipid therapy.

Next up is **carbon monoxide** – you might remember this discussion from the Hematology/Oncology chapter. Let's revise!

Carbon monoxide binds to hemoglobin with higher affinity than oxygen – which is why the first step in treatment is high-flow oxygen

Risk factors: smoke inhalation and poorly functioning heating systems

Patients who smoke can have CO levels up to 10% at baseline, nonsmokers up to 3%

Initial presentation is often vague: headache is the most common presenting symptom but patients can also have nausea, dizziness, confusion, etc.

‘Cherry red’ lips and skin are often quoted but rarely seen. In reality, other than changes in mental status the physical exam is typically unremarkable.

The most common cause of death from CO poisoning is myocardial ischemia

Hyperbaric oxygen (HBO) is indicated in the following cases of CO poisoning:

- ▶ Loss of consciousness, coma, or seizures
- ▶ CO levels > 25% regardless of symptoms (>15% in pregnant women)
- ▶ Myocardial ischemia or life-threatening dysrhythmia
- ▶ Evidence of end-organ damage regardless of CO level
- ▶ Persistent symptoms after treatment with high-flow oxygen

*** *Hyperbaric oxygen does not lower mortality or risk of MI or dysrhythmia*

Pay close attention when treating victims of smoke inhalation: carbon monoxide poisoned patients present similarly to those also poisoned by cyanide. Cyanide toxicity should be considered in all smoke inhalation patients with at least two of the following: carbonaceous material in the oropharynx, neurologic dysfunction, metabolic acidosis, and serum lactate >8.

- **Cyanide**

- ▶ Inhibits mitochondrial cytochrome complex so cells switch to anaerobic metabolism → lactic acid formation and **metabolic acidosis**
- ▶ While CO is odorless, cyanide can have a ‘bitter almond’ odor

- ▶ Depending on the route of exposure, toxicity may be delayed. When inhaled it's often immediate – but via ingestion or dermal exposure symptoms may be delayed up to several hours
- ▶ Severe cyanide toxicity can lead to delayed-onset Parkinsonism and other neurologic sequelae (the basal ganglia are specially sensitive to cyanide)
- ▶ Treatment: if hydroxocobalamin is available, it is the best option: sodium thiosulfate + hydroxocobalamin. The traditional kit (which is no longer manufactured) uses amyl nitrite, sodium nitrite, and thiosulfate.

Treatment with amyl nitrite or sodium nitrite is contraindicated if there is concomitant CO poisoning.

For comparison, with carbon monoxide toxicity patients' lips can appear bright red and their skin may be pale but *not* cyanotic. With cyanide, patients' skin may appear deceptively normal and in severe cases of cyanide poisoning, patients may be cyanotic (however most patients with cyanide poisoning are not cyanotic).

- Clonidine overdose can mimic opioid overdose (miosis, respiratory depression, coma). Treatment is mostly supportive care. Naloxone may be beneficial and really has no risk.

Which of the following is an indication for digibind in an adult patient with acute digoxin overdose?

- A) Sinus bradycardia with heart rate 55
- B) Serum digoxin level 12
- C) Ingestion of 8 grams of digoxin
- D) Serum potassium 5.8

Answer: D

Explanation: Digoxin toxicity is characterized by GI symptoms, hyperkalemia, and life-threatening dysrhythmias. Digoxin has a narrow

therapeutic index. Chronic toxicity may occur in the elderly and in those with renal impairment. Digoxin-specific Fab fragments (Digibind) is the definitive treatment. Acute toxicity can be life-threatening and digibind is indicated in cases of cardiac arrest, potassium > 5 , life-threatening dysrhythmias or high degree AV blocks, serum level > 15 , or $> 10\text{mg}$ ingestion (adult) and 5mg ingestion (child). In cases of hyperkalemia, calcium is traditionally avoided due to the risk of a 'stone heart' although this is not well proven. In hyperkalemic patients, digibind is still first-line treatment.

Bonus learning point: After giving digibind, when should a repeat digoxin level be checked?

After digibind, digoxin levels should not be measured for at least three weeks

Bonus bonus learning point: Which dysrhythmia is pathognomonic for digoxin toxicity?

Paroxysmal atrial tachycardia (ectopic atrial tachycardia with high-grade AV block) is pathognomonic; PVCs are the most common dysrhythmia.



Bonus bonus bonus learning point: How many vials of Digibind should be given? Empiric treatment is 5 vials for children, 10 vials for hemodynamically unstable adults, and 20 vials if the patient is in cardiac arrest. Each vial will bind about 0.5mg of digoxin. To calculate the exact dose, take the ingested dose (mg) $\times 1.6$.

- Lye exposure
 - ▶ Lye (aka sodium hydroxide) is found in many solvents and cleaners and is highly toxic through contact, inhalation, or ingestion
 - ▶ For topical exposure, *first clean the skin by brushing it off and then wash* the affected area thoroughly with water

- GHB (gamma-hydroxybutyric acid)
 - ▶ **Classic presentation: intermittent bouts of agitation and a quick return to a comatose state**
 - ▶ Can cause hypothermia and significant bradycardia without hemodynamic compromise
 - ▶ Treatment: supportive
- **Hydrofluoric Acid**
 - ▶ Used as a rust remover and for chrome/metal cleaning
 - ▶ Oral ingestion has a very high mortality rate
 - ▶ Onset and severity of symptoms are related to concentration: dilute solutions may have delayed onset up to 24 hours post-exposure. Immediate pain implies severe injury.
 - ▶ Can lead to hyperkalemia, hypocalcemia, and hypomagnesemia which can lead to QT prolongation. Primary cause of death is arrhythmias.
 - ▶ Treatment: irrigate affected area with water and apply topical calcium gluconate gel
 - ◆ If pain persists, inject calcium gluconate intradermally into the area (do not inject directly into digits)
 - ◆ If pain persists, give intraarterial calcium gluconate
 - ◆ *Resolution of pain indicates successful treatment*
- **Hydrocarbons**
 - ▶ Found in fuels, paints, paint removers, rubber cement, etc.
 - ▶ Two main groups
 - ◆ Aromatic: carbon moieties arranged in a circle
 - ◆ Aliphatic: carbon moieties arranged in a linear/branched pattern
 - ▶ Lungs are the most commonly affected organ ('sniffing' or aspirating) Inhalational exposure and dermal contact aren't usually very serious – aspiration can lead to systemic toxicity however
 - ▶ If patients are observed for six hours and have a negative chest x-ray they can safely be discharged home
 - ▶ Corticosteroids and antibiotics have no benefit; treatment is supportive

If there's any question about hydrocarbons, it will be about which properties increase toxicity: low viscosity, low surface tension, and high volatility

A sewer worker presents to the ER after being found unresponsive on the job. He smells like the breakfast your wife made for you this morning. The paramedics look to you for a diagnosis. The nurses stop placing IVs and stop chest compressions and look to you for a diagnosis. In fact, everyone in the room stops what they're doing and looks to you. Other than feeling a little hungry, you have no idea. "Um, let's check his pockets?" you suggest. "Nothing in here but some blackened coins," the tech informs you. "Well," you say, suddenly feeling more confident, "I think my job here is done...." and you walk out the room leaving everyone bewildered. "Hydrogen sulfide!" you shout, poking your head back in to hear a collective sigh from the team as everyone realizes you're a genius.

- **Hydrogen Sulfide**

- ▶ aka 'sewer gas'; found in sewers and swamps as well as oil refineries Forms a complex bond with Fe and inhibits the mitochondrial cytochrome complex
- ▶ Clue: discolored copper coins in the pocket of a patient
- ▶ Rotten egg odor
- ▶ Treatment: amyl nitrite, sodium nitrite
 - ◆ Exchange transfusion may play a role
 - ◆ Hyperbaric oxygen may play a role

- **Iron**

- ▶ Stages of toxicity

30 mins-6 hours	GI phase (nausea, vomiting, diarrhea)
6-24 hours	Latent phase (resolution of symptoms)
12-24 hours	Metabolic acidosis, shock, organ failure, coma
2-3 days	Hepatic failure
3-6 weeks	Bowel obstruction

- ▶ *Presence of GI symptoms indicates significant exposure*
 - ◆ *If no vomiting has occurred for six hours post-ingestion, the patient likely did not ingest a toxic dose and is considered medically cleared*
- ▶ > 40mg/kg is generally accepted as a toxic dose
- ▶ Presence of radiopaque pills on an abdominal film confirms diagnosis
 - ◆ Gastric lavage and whole bowel irrigation may be beneficial
- ▶ **Indications for deferoxamine**
 - ◆ **Severe symptoms (AMS, GI hemorrhage, hemodynamic instability, persistent vomiting)**
 - ◆ **Anion gap acidosis**
 - ◆ **Serum iron level > 500**
 - ◆ **Serum iron level > TIBC**
 - ◆ **Significant number of pills on abdominal radiograph**

Mr. Opey Oid presents to the ER with chronic arm pain. He was shot in the forearm six years ago and has had pain ever since. This is his twelfth visit this month. He mentions constipation (“duh, too many narcotics,” you think to yourself), fatigue (“pain’s keeping me awake doc”), and lightheadedness (“dude, your freaking name is ‘opioid’”!). As you’re signing his prescription for another narcotic refill, you relate this hilarious story to your colleague, who just so happens to be studying for his written boards exam and remembers reading something in an awesome prep book. “Dude, check a lead level!” he shrieks like a little girl.

- **Lead**

- ▶ Presents with nonspecific signs: abdominal pain, constipation, irritability, anemia, memory disturbances. It can also present with wrist/foot drop.
- ▶ Main route of exposure:
 - ◆ GI tract in children
 - ◆ Respiratory tract in adults
- ▶ Lead has a short half-life in blood but a half-life of decades in the bones
- ▶ Diagnosis: blood level

- ▶ Treatment: remove from the environment, consider succimer
- **Lithium**
 - ▶ Lithium does not bind well to charcoal; polyethylene glycol (Golytely) should be used for whole bowel irrigation in cases of acute overdose. Administer 500mL to 2L every hour until the rectal effluent is clear.
 - ▶ Monitor sodium levels closely as hyponatremia can exacerbate neurotoxicity
 - ▶ Lithium levels don't always correlate with toxicity in acute ingestion and should be repeated every four hours
 - ▶ Dialysis is an option and should be discussed with a toxicologist. Know the indications! Levels > 5, levels > 4 in patients with creatinine > 2, or the presence of decreased level of consciousness or seizures regardless of level. When indicated, multiple sessions of dialysis may be needed until the level remains 1 for eight hours after dialysis.
- Mercury – consuming liquid mercury from a thermometer is not very problematic by itself; the inhalation of mercury vapors from the liquid is more dangerous (causes interstitial fibrosis of lungs)
- **MAO Inhibitors**
 - ▶ MAO degrades catecholamines (dopamine, serotonin, NE); taking an MAO inhibitor can lead to a severe hypertensive crisis as can eating foods that contain tyramine (sympathomimetic)
 - ◆ Foods such as cheese, fava beans, and certain alcoholic beverages
 - ◆ Symptoms are classically delayed 6-12 hours after ingestion
 - ▶ Meperidine and dextromethorphan are contraindicated with MAO inhibitors as concurrent use can lead to severe hyperthermia

Which of the following is true regarding ingestion of mushrooms?

- A) Symptoms that begin within 6 hours of ingestion imply severe toxicity
- B) The most common initial symptoms are neurologic (altered mental status,

seizures)

C) Amanita mushrooms are associated with hepatotoxicity

D) They are the best topping on any pizza

Answer: C

Explanation: If symptoms are acute in onset (< 6 hours), ingestion is unlikely to be life-threatening. If there is delayed onset of vomiting and diarrhea, suspect Amanita mushrooms, which may be hepatotoxic. Mushrooms are a great topping but not as good as olives.

Amanita	Hepatotoxicity
Psilocybin	Hallucinations, euphoria
Gyromitrin	Seizures (treatment: vitamin B6)
Coprine	Disulfiram-like reaction
Orellanine	Nephrotoxicity

Amanita muscaria has been known to appear in questions. The key is its treatment: it does not act at muscarinic receptor sites so atropine and physostigmine are not recommended.

- **Neuroleptic malignant syndrome**

- ◆ (NMS) Life-threatening
- ◆ AMS, hyperthermia, rigidity
- ◆ Not dose-dependant
- ◆ Treatment: supportive care, benzos, dantrolene, bromocriptine

It's easy to confuse and important to distinguish three conditions: NMS: altered mental status, rigidity, hyperthermia

Malignant hyperthermia: rigidity and hyperthermia, but it's a rare genetic disorder
Serotonin syndrome: shivering, hyperreflexia, clonus, nausea/vomiting/diarrhea

- **Opioids**
 - ▶ Classic triad: miosis, respiratory depression, sedation
 - ▶ Can cause noncardiogenic pulmonary edema
 - ▶ Treatment: naloxone (use with caution as it may precipitate withdrawal)
 - ▶ **Methadone is associated with prolonged QT intervals** and patients may develop torsades. The half-life of methadone is significantly longer than naloxone so patients may require multiple doses and should be monitored closely.
- **PCP**
 - ▶ NMDA receptor antagonist
 - ▶ The only illicit drug that causes vertical nystagmus. Horizontal and rotary nystagmus may also occur.
 - ▶ Consider the possibility of rhabdomyolysis
 - ▶ Treatment of PCP-induced seizures: benzodiazepines
 - ▶ False-positive drug screens with ketamine and dextromethorphan

Dextromethorphan, found in cough syrup, is also an NMDA receptor antagonist. Overdose may cause rotary nystagmus, mydriasis, hyperthermia, and visual hallucinations. It is also a serotonin reuptake inhibitor and may cause serotonin syndrome.

- **Phenytoin**
 - ▶ Toxicity symptoms include: ataxia, nystagmus, vomiting, lethargy, coma
 - ▶ Treatment: multidose activated charcoal

Which of the following is an indication for dialysis in a case of salicylate overdose?

- A) Pulmonary edema
- B) Intractable vomiting
- C) pH 7.3
- D) Salicylate level 90 mg/dL

Answer: A

Explanation: Tinnitus is one of the earliest findings of salicylate toxicity and generally resolves as the toxicity improves. Symptoms can progress to nausea, vomiting, AMS, hyperthermia, and even death. Patients need adequate fluid resuscitation and bicarbonate can also help: but use caution as salicylate toxicity can lead to noncardiogenic pulmonary edema. This is an absolute indication for dialysis. Additional indications for dialysis include renal failure, significant hemodynamic instability, severe neurologic symptoms (convulsions, coma), and levels > 120 mg/dL (> 100 if more than 6 hours post-ingestion). Levels should be checked every 2 hours until they are clearly declining.

- ▶ Oil of wintergreen has very high concentration of salicylate and even a small amount can be toxic
- ▶ **Acid-base abnormalities**
 - ◆ Early: respiratory center stimulated causing tachypnea and subsequent respiratory alkalosis
 - ◆ Later: anion gap metabolic acidosis
 - ◆ Net effect: most patients have either a primary respiratory alkalosis, or, more commonly, a mixed respiratory alkalosis-metabolic acidosis
- ▶ Urinary alkalization is an essential part of treatment (and not a substitute for dialysis) – even in the presence of mild alkalemia from early respiratory alkalosis. Give a bolus of 1-2mEq/kg IV, then put 3 amps of bicarb in 1L D5W and run it at 2-3 mL/kg/hr; maintain a urine pH > 7.5
- ▶ **Intubation is dangerous and should be used only in cases of clear respiratory failure.** Respiratory alkalosis keeps salicylate ions in the blood, preventing them from crossing the blood-brain barrier (somewhat protective). The brief period of apnea after administering paralytics while prepping for intubation can cause an acute respiratory acidosis. Also, the high respiratory rate and minute ventilation in un-intubated patients (which is, again, somewhat protective) can be hard to replicate on a ventilator – therefore intubation should in general be reserved for those with

hypoventilation. In summary: **if necessary, ensure high minute ventilation and maintain a state of alkalemia with a serum pH of 7.50.**

- **Tricyclic Antidepressants**

- ▶ Treatment: alkalinization of the blood and increase serum sodium concentration by giving sodium bicarbonate
- ▶ Indications for bicarbonate: QRS widening, hypotension refractory to fluid bolus, and ventricular arrhythmia
- ▶ *Lidocaine is the antiarrhythmic of choice*
- ▶ Treat seizures with benzodiazepines; if refractory use barbiturates (phenytoin can be pro-arrhythmic so use should be avoided)

There's a very unique constellation of symptoms caused by **valproic acid** toxicity: it raises ammonia levels *without* causing hepatic dysfunction. Consider valproic acid overdose in patients who are somnolent with **elevated ammonia levels and normal LFTs**. The treatment is L-carnitine and is also worth knowing.

- **Vitamins**

- ▶ Vitamin A deficiency: night blindness
- ▶ Vitamin A excess: hepatotoxicity, hypercalcemia, intracranial HTN
- ▶ Vitamin B3 (niacin) excess: flushing
- ▶ Vitamin B6 (pyridoxine) excess: peripheral neuropathies
- ▶ Vitamin D excess: hypercalcemia

- **Warfarin toxicity**

- ▶ In cases of overdose, clinically significant anticoagulation will be delayed
- ▶ > 6 hours; there should not be any active bleeding acutely
- ▶ PT/INR should be checked on arrival and if performed within the first six hours post-ingestion, should be normal
- ▶ Treatment is vitamin K PO; never administer vitamin K without first checking the INR
- ▶ A follow-up INR should be checked in 48 hours (if accidental ingestion the patient can be discharged home in the meantime)

- ▶ A normal INR 48 hours post-ingestion excludes significant warfarin overdose

Scenario: A 50 year old male presents after accidentally taking an entire bottle of warfarin one hour prior to arrival. He has no complaints.

Management? Check a baseline INR. Administer vitamin K PO. Discharge home with instructions to have a repeat level in 48 hours. *Unless* the patient needs anticoagulation (ie recent pulmonary embolism) – then only administer vitamin K if the INR is significantly elevated.



PRIMARY SURVEY

Which of the following is considered acceptable preoxygenation before intubation?

- A) 8 breaths with maximum inhalation and exhalation
- B) 2 minutes of breathing with a nonrebreather or other high FiO₂ device
- C) 2 minutes of assisted bag-valve-mask breaths
- D) 4 breaths with maximum inhalation and exhalation

Answer: A

Explanation: Cooperative patients can take 8 breaths and achieve adequate levels of preoxygenation. Many patients in the ER cannot comply, and in such cases three minutes of preoxygenation with a nonrebreather is appropriate. Patients should be preoxygenated with their head elevated (not completely supine) if at all possible.

What is the paralytic agent of choice in patients at high risk of desaturation?

- A) Etomidate
- B) Rocuronium
- C) Midazolam
- D) Succinylcholine

Answer: B

Explanation: Studies have shown that patients who receive rocuronium take an average of more than two minutes longer to desaturate compared to those who receive succinylcholine. Succinylcholine is the only depolarizing neuromuscular blocking agent given amongst these choices. It can induce fasciculations which may cause increased oxygen use and more rapid desaturation.

- ▶ Contraindications to using succinylcholine:
 - ◆ Hyperkalemia
 - ◆ Severe crush injuries
 - ◆ Burns > 7 days old
 - ◆ Penetrating eye injury
 - ◆ Neuromuscular disease
 - ◆ Personal or family history of malignant hyperthermia

Did you know? Liver disease decreases levels of cholinesterase and will prolong the activity of succinylcholine

If you can't establish an airway orally, you can always try the nose...

- ▶ Nasotracheal intubation contraindications:
 - ◆ Obvious facial trauma/fracture
 - ◆ Basilar skull fracture
 - ◆ Apnea

So if a patient is not taking breaths on their own, you **CANNOT** do a **nasotracheal intubation!** And if you can't get an airway there, there's always the neck (cricothyrotomy) – more on that later...

- ▶ **NEXUS criteria** to clear C-spine: Alert/oriented
 - ◆ No focal neurologic deficits
 - ◆ No midline tenderness
 - ◆ No painful distracting injury
 - ◆ No signs of intoxication

**** C-spine immobilization is now controversial and of questionable benefit. There have been no cases reported of worsening C-spine injury in alert cooperative trauma patients as a result of not immobilizing them. Spinal immobilization can actually lead to more harm (improperly placed, increased pain, barriers to airway management, etc) ****

- Breathing – things that require immediate attention:
 - ▶ Tension pneumothorax is treated with needle thoracostomy followed by chest tube placement (do not do a chest x-ray first)

- ▶ For a sucking chest wound place a *three-sided* occlusive dressing so that air won't enter the chest cavity during inspiration but can leave during expiration

- Circulation

Hemorrhagic Shock Classification

Class I	< 15% blood loss (no significant changes)
Class II	15-30% blood loss (tachycardia , dec cap refill)
Class III	30-40% blood loss (shock, hypotension , AMS)
Class IV	> 40% blood loss

- ▶ Carotid pulse ~ BP > 60
- ▶ Femoral pulse ~ BP > 70
- ▶ Radial pulse ~ BP > 80

- Disability

- ▶ Brief neurologic exam / glasgow coma score

- Exposure

- ▶ Undress the patient and perform a quick head-to-toe exam
- ▶ Have warm blankets ready to prevent hypothermia

- Trauma is the most common cause of death in adults age 20-40

PEDIATRIC TRAUMA

- Most common cause of death in children over the age of one: trauma
 - ▶ Head trauma is the most common cause of traumatic death in children
- Infants have a disproportionately larger occiput – when they are layed

flat they have a natural passive flexion of the neck because of the large occiput. Placing padding beneath the torso will preserve neutral alignment. Infant's tracheas are shorter as well which can result in right mainstem intubation.

Cuffed vs uncuffed tubes is an ongoing debate. As of now, the AHA and PALS endorse the use of cuffed tubes, but it is not without controversy.

Which size ET tube should be used?

Cuffed ET tube size: $(\text{age} / 4) + 3.5$

Uncuffed ET tube size: $(\text{age} / 4) + 4$

A needle cricothyroidotomy instead of a surgical cricothyroidotomy should be performed in children younger than 8 years if attempts at direct laryngoscopy are unsuccessful. **Do not perform a surgical cricothyrotomy in children < 8 years of age** (this is controversial but PALS teaches 8 years as the cutoff)

- Intraosseus (IO) access is useful when vascular access is difficult or likely to lead to delayed management in emergency situations. IO lines can be used to administer fluids, blood products, and medications. In fact, any medication that can be given through a central line can be given IO with no change in dosage. The sternum allows for the most rapid infusion rates but this requires a special device – for this reason the proximal humerus is generally the preferred site as the infusions enter the circulation at the fastest rate (other than the sternum). In children, the proximal tibia is often selected due to easily palpated landmarks. Contraindications to placement include any limb with suspected fracture or overlying skin infection.

Which of the following is the preferred site of access for peripheral vein cutdown?

- A) Cephalic vein
- B) Median cubital vein
- C) Basilic vein

D) Popliteal vein

Answer: C

Explanation: The preferred site is always the largest accessible vein that will cause the least disruption in resuscitation. The basilic vein is the preferred vein if the upper extremity is used.

A 2 year old child is involved in a motor vehicle accident. He arrives in the ER with a blood pressure of 60/p and a heart rate of 150. You suspect that he may be going into shock and will require fluid resuscitation. Paramedics have been unable to establish an IV after three attempts. What should be done next?

- A) Insert a central line
- B) Have a nurse attempt to place a peripheral IV
- C) Insert an IO
- D) Perform a peripheral venous cutdown

Answer: C

Explanation: ATLS guidelines state that in children younger than 6 years of age, an IO should be attempted before inserting a central line. Continuing attempts to place a peripheral IV will only further delay care. Once access has been established, an initial fluid bolus of 20 mL/kg should be given, repeated up to three times total.

- Rib and sternal fractures are rare as children's bones are so malleable – fractures of these areas suggest a high force of impact

Let's say a child is involved in a car accident. He is complaining of neck pain and left arm tingling. CT scan of the cervical spine is negative. If you're thinking about removing the cervical collar at this point, then it's time for a...

Knowledge bomb! SCIWORA, spinal cord injury without radiographic (x-ray/CT) abnormality, should be suspected in patients with blunt cervical

*trauma and neurologic deficits. It is most common in younger children (due to relative laxity of the ligaments) but can occur in adolescents/adults less frequently. In the majority of cases **SCIWORA** involves the **cervical vertebrae** and an **MRI** will show the lesion.*

- Pseudosubluxation of C2 on C3 is an anatomic variant seen in up to 20% of children; C2 is anteriorly positioned compared to C3. Follow the spinolaminar line connecting anterior portions of the spinous processes of C1 and C3 – the line should be within 2mm of the spinous process of C2.



- Ligaments are stronger in children than adults, so forces that would typically cause a sprain in an adult can cause a fracture in children
- Circumoral burns can occur in children who chew on electrical cords
 - ▶ Delayed complication: hemorrhage from labial artery after 2-3 days when the scab prematurely dislodges
- Consider child abuse in children with inconsistent injury/history patterns
- Contact child protective services for all presumed cases of abuse – even if parents are cleared of wrongdoing you cannot be held liable for calling

PREGNANCY AND TRAUMA

- Normal vital sign changes in pregnancy:
 - ▶ HR increases by 15 bpm in the first trimester
 - ▶ Systolic and diastolic BP drop by 10 mmHg in the first trimester and bottom out around 28 weeks
 - ▶ Respiratory alkalosis occurs due to hyperventilation and compensatory metabolic acidosis
- Blunt trauma is the leading cause of maternal death in trauma cases
- Penetrating trauma: maternal mortality is low, fetal mortality is high
- Enlarged uterus tends to protect maternal retroperitoneal structures

ATLS: there is no increase in pregnancy-specific risks after the deployment of airbags

- Maternal stabilization is the most important factor in preventing fetal demise
- Chest tubes should be placed 1 or 2 levels higher compared to non-pregnant women (3rd or 4th intercostal midaxillary)
- Preferred diagnostic modalities in 1st trimester for abdominal trauma (in order): ultrasound, DPL, CT scan; in 2nd and 3rd trimester avoid DPL

Paramedics call to inform you they're bringing in a pregnant woman who says she's 8 months along and was in a motor vehicle accident. She is hypotensive with a blood pressure of 70/p. They have her immobilized and flat on a spine board. How should you respond?

- A) 'Hypotension is normal at this stage of pregnancy'
- B) 'Give her a dose of epinephrine'
- C) 'Displace the uterus'

- D) 'Start chest compressions'
- E) 'Do they have a name picked out yet?'

Answer: C

Explanation: After 20 weeks the IVC can be compressed by the uterus when supine. Place a towel/wedge, or manually displace the uterus, to prevent this.

- All pregnant women who suffer blunt trauma and are > 20 weeks require at least four hours of fetal monitoring. Fetal distress is indicated by decelerations. Development of uterine contractions is the most common consequence of maternal trauma and most will resolve spontaneously.
- Fetomaternal hemorrhage is detected using the Kleihauer-Betke test: solution is added to maternal blood. Adults cells remain colorless while fetal red cells turn bright purple-pink. Sensitivity of this test is very low.

What is the most sensitive test for detecting placental abruption after trauma?

Kleihauer-Betke?

Ultrasound?

Continuous fetal monitoring!

- Uterine Rupture
 - ▶ Symptoms/signs: loss of uterine contour, palpable fetal parts
 - ▶ Seen more often in women with previous C-section
- If the mother has not responded to **four minutes of resuscitation** and remains in cardiac arrest, perform immediate emergency C-section

HEAD TRAUMA

- In patients with head trauma remember to always rule out concomitant cervical spine injury
- Skull Fracture
 - ▶ Linear non-depressed fractures don't require treatment
 - ▶ Open or depressed fractures require antibiotics and neurosurgery evaluation
 - ▶ Basilar Skull Fracture
 - ◆ Skull x-rays and CT are often negative, may require high-resolution CT scan with thin slices
 - ◆ CSF oto/rhinorrhea, hemotympanum, mastoid ecchymosis (Battle's sign), purplish discoloration around the eyes (Raccoon eyes)
 - ◆ Most CSF leaks resolve spontaneously within one week

A patient presents with head injury and altered mental status - this is the CT scan:



Intracerebral Hemorrhage, right? The patient is going to have increased intracranial pressure so what is your management?

#1 - They'll need a definitive airway. When performing RSI, premedicating with lidocaine *can* help prevent further increases in ICP (studies have conflicting results).

#2 - Don't allow the patient to develop hypotension

#3 - Elevating the head of the bed to 30 degrees will reduce ICP

#4 - Mannitol and/or hypertonic saline have been shown to be beneficial. They're best used in cases of impending herniation and should not routinely be given.

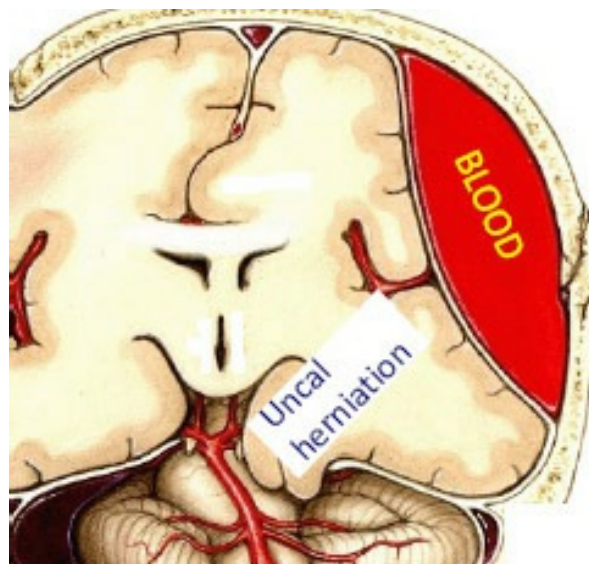
#5 - Hyperventilation should not routinely be used and benefits are almost outweighed by harm (can exacerbate cerebral ischemia). **If used, the target pCO₂ is 30-35mmHg.**

If the patient has a seizure, it should be treated aggressively. However, *prophylactic* antiepileptics are not recommended.

Patients with a head bleed may become bradycardic – this is known as ‘Cushing’s reflex’ and is a sign of impending herniation (increased ICP)

There are a few different types of herniation; the one you may be asked about is:

Uncal (transtentorial) herniation – where the innermost part of the temporal lobe, the uncus, is compressed and moves toward the brainstem. It can put pressure on CN III, leading to an ipsilateral fixed/dilated pupil.



Classic presentation for uncal herniation: ipsilateral fixed dilated pupil + contralateral hemiplegia

- Diffuse Axonal Injury is a difficult diagnosis to make by CT scan and can be seen following severe head trauma in [mostly] comatose patients. Duration of the coma correlates with severity of injury. Look for multiple lesions at the gray-white matter junctions.



- Concussion = transient alteration in mental status after head trauma with lack of focal neurologic findings
- Most common abnormal finding on CT scan in elderly patients with head trauma: cerebral contusion



A patient presents to the ER after being punched in the face. He's having difficulty seeing out of his left eye where he was hit. You notice the left eye does seem to be protruding a little more than the right one. What is the next step in treatment?

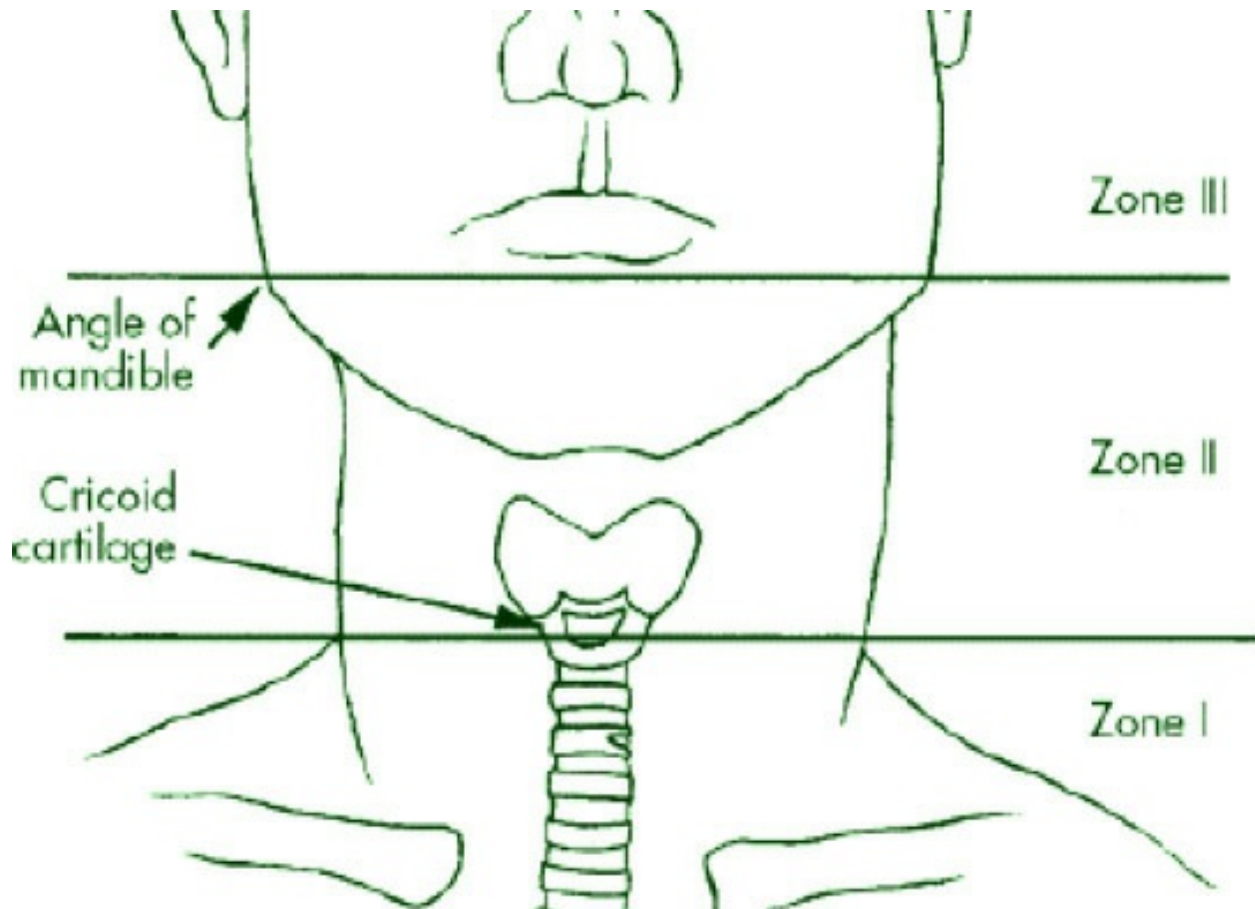
- A) Call the ophthalmologist
- B) Order x-rays of his face and orbits
- C) Perform a lateral canthotomy
- D) Start timolol to reduce his intraocular pressure
- E) Place a shield over his eye

Answer: C

Explanation: Retrobulbar hemorrhage can be seen following ocular/head trauma. Diagnosis is with a non-contrast CT scan of the face/orbits. In patients with monocular vision loss and proptosis, management includes performing a lateral canthotomy and notifying ophthalmology. Complications include ocular compartment syndrome and central retinal artery occlusion.




NECK TRAUMA

- It's important to determine if the platysma has been violated but **do not probe neck wounds in the ER**



Management of patients with concern for vascular injury:

- Zone I: angiography, esophageal evaluation, and bronchoscopy
- Zone II: mandatory operative evaluation used to be the recommendation but most guidelines lean towards angiography first in the stable patient
- Zone III: angiography
- **‘Hard signs’** indicate significant injury and are indication for operative evaluation:
 - ▶ Expanding hematoma
 - ▶ Severe active bleeding or major hematemesis
 - ▶ Vascular bruit or absent pulses
- **‘Soft signs’**:

- ▶ Dyspnea, minor hematemesis, stridor
 - ▶ Hoarseness
 - ▶ Subcutaneous emphysema
 - ▶ Crepitus
- **Esophageal Injury** - difficult to diagnose, but full of buzzwords to help you remember!
 -  Patient with a left sided pneumo/hemothorax *without* a rib fracture
 -  Odynophagia (painful swallowing)
 -  Lateral neck film showing subcutaneous emphysema

Gastrograffin (water-soluble contrast) should be used rather than an esophagogram, which can provoke an inflammatory mediastinitis

What if a patient has neck pain following an MVA but their CT scan is normal? If the patient still has midline tenderness or painful range of motion, check flexion/extension views to rule out ligamentous injury.

- Laryngeal Fracture
 - ▶ Symptoms/signs: hoarse voice, stridor, and subcutaneous emphysema
 - ▶ **Diagnosis: plain film showing elevation of the hyoid bone above C3**

Anterior Cord Syndrome: **flexion** injury or anterior spinal artery occlusion; motor paralysis and loss of pain and temperature, preservation of position, light touch and vibration

Central Cord Syndrome: **hyperextension**; weakness in arms more than legs

Brown-Sequard Syndrome: **hemisection** of the spinal cord; ipsilateral motor and position loss and contralateral loss of pain and temperature beginning one to two levels below the level of injury

- Jefferson Fracture – unstable fracture of C1 from axial load
- Most C-spine fractures in pediatric patients and in the elderly involve C1-3
- Be able to differentiate ‘spinal shock’ from ‘neurogenic shock’:
 - ▶ **Spinal shock** occurs after a **spinal cord injury** – usually a complete transection. **Reflexes** below the level of injury are **decreased or lost** and **flaccid paralysis** may also occur at all levels below the injury – however there is NO circulatory collapse and spinal shock is *not* life-threatening. Treatment is supportive and potentially surgical depending on any vertebral fractures.
 - ▶ **Neurogenic shock** is caused by CNS trauma (whether in the brain or in the spinal cord **above the level of T6**) causing a **loss of sympathetic stimulation** to blood vessels. This leads to vasodilation (**hypotension**) and **bradycardia** (from unopposed vagal activity). This may lead to organ failure and **death if untreated**. **Treatment** consists of **vasopressors** (typically dopamine or phenylephrine to start with) and atropine as needed for bradycardia.

What about the trauma patient who is paralyzed and has priapism on exam? This is a classic example of spinal shock. It is usually self-limited and requires no specific treatment. It occurs at the moment of motor and sensory paraplegia and there is no period of delay. From a boards-y standpoint, know that priapism following spinal cord injury is ‘*high-flow*’ (non-ischemic) priapism; in other words the blood within the corpus is *arterial* in nature.

CHEST TRAUMA

- Chest wall injuries are associated with increased risk of other injuries (due to high force of mechanism)

Indications for ED thoracotomy

Penetrating trauma	Traumatic arrest with previously witnessed cardiac activity (prehospital or in-hospital)
	Unresponsive hypotension
Blunt trauma	>1500 mL blood from chest tube
	Unresponsive hypotension

ATLS guidelines: ED thoracotomy is not indicated unless a surgeon is available

Beware damaging the **phrenic nerve** when incising the pericardium: this can lead to unilateral diaphragmatic paralysis

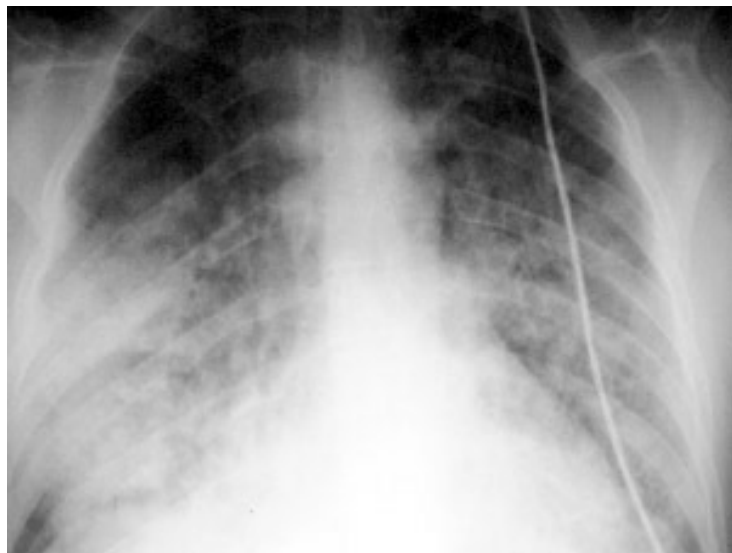
- In penetrating trauma to the chest, the right ventricle and right atrium are most commonly injured due to their anterior location
- Blunt trauma + hypotension – only three areas that someone can lose enough blood to become hypotensive:
 - ▶ Pelvic fracture
 - ▶ Intra-abdominal injury
 - ▶ Intra-thoracic injury
- Rib fractures may not be seen on x-ray
 - ▶ Fracture of ribs 1-3 can be associated with *mediastinal* injury
 - ▶ Fracture of ribs 9-12 can be associated with *intra-abdominal* injury
 - ▶ **Flail chest**
 - ◆ 3 or more adjacent ribs fractured in two places
 - ◆ Associated with significant morbidity from pulmonary contusion
 - ◆ Most patients will need some positive pressure ventilation – in distressed patients have a low threshold to intubate
- **Blunt Myocardial Injury**
 - ▶ Most often occurs following an MVA
 - ▶ EKG is the best screening test; role of biomarkers (troponin)

unproven

- ▶ Few patients will develop an arrhythmia that requires treatment

- **Pulmonary Contusion**

- ▶ Generally develop in first 24 hours and resolve by one week
- ▶ Often not seen on initial chest x-ray but associated with rib fractures
- ▶ Place the patient with the unaffected lung down (dependent position)
- ▶ Treatment: pain control, pulmonary toilet, fluid restriction
- ▶ Patients with significant hypoxia may require intubation

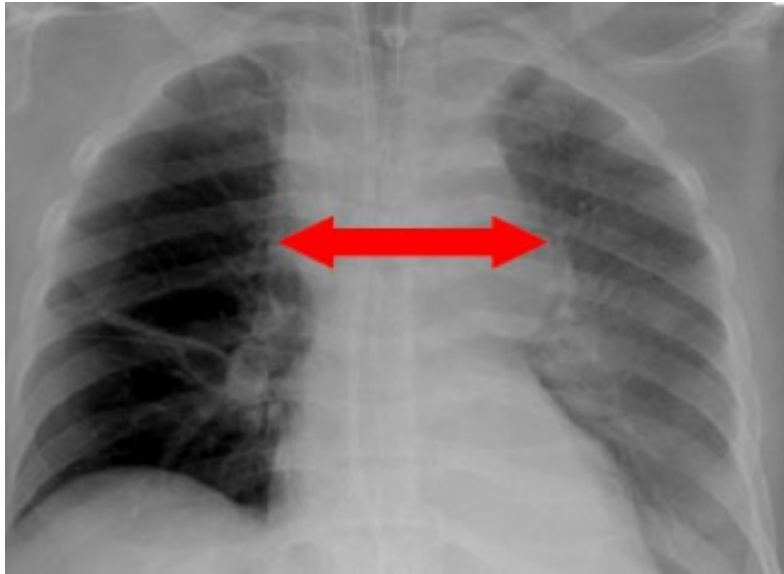


One way the question has been known to appear: in a patient with the x-ray shown above, which of the following treatments is most beneficial? The x-ray shows a pulmonary contusion, so you can presume they have some broken ribs and therefore flail chest. Options might include antibiotics, chest tube placement, prophylactic intubation, etc. But the answer is: IV fluid restriction.

- **Aortic Rupture**

- ▶ Most common site of injury: the descending aorta just distal to the subclavian artery
- ▶ Very high mortality rate
- ▶ Best initial screening test is a chest x-ray (wide mediastinum), confirmatory test is CT scan

- ▶ There may be a pulse difference between upper and lower extremities



Wide mediastinum! If there was blunt chest trauma, be concerned about aortic rupture!

- **Hemothorax**

- ▶ Up to 300 mL of blood is needed for blood to appear on an x-ray
- ▶ Treatment: place large bore chest tube (minimum 36 French)
- ▶ Indications for surgical thoracotomy:
 - ◆ Immediate drainage of > 1500 mL blood
 - ◆ > 200 mL/hr for 2-4 hours

Autotransfusion is a process wherein a person receives their own blood for a transfusion. Classically associated with major hemothoraces: as the blood is removed via chest tube, it's cycled back into the patient. Advantages are that the blood is readily available and [obviously] matched, and it can be used in patients with rare blood types. Plasma and platelets will still get depleted so patients will need those in addition to the autotransfusion.

- **Pneumothorax**

- ▶ Typical presenting symptoms include chest pain and shortness of breath. Subcutaneous emphysema and tracheal deviation may also

be seen.

- ▶ **Best seen on an upright expiratory chest film** (but should ideally be diagnosed clinically, prior to obtaining films)
- ▶ Open pneumothorax: place a 3-sided petroleum gauze over the wound to create a one-way valve, thereby preventing formation of a tension pneumothorax

For pneumothorax, chest tubes should be directed anteriorly. For hemothorax, tubes should be directed posteriorly. If tubes are advanced too far into the chest, they will cause severe pain as they push against the mediastinum.

- ▶ Tension pneumothorax
 - ◆ Decreased breath sounds, distended neck veins, tracheal deviation
 - ◆ Can lead to cardiac arrest
 - ◆ Treatment: immediate needle thoracostomy followed by chest tube placement (don't wait for an x-ray!)

Pneumothoraces typically resolve at a rate of 1-2% per day on their own. For instance, if a patient has a pneumothorax involving 15% of his lung and is discharged home, it will take about two weeks for it to be completely resolved.

- Pneumomediastinum can occur following trauma to the chest. Consider esophageal injury as well and an esophagram (barium swallow study) to help further evaluate. Most cases are managed with supportive care. 'Hamman's crunch' refers to a crunching sound that can be heard during systole.



- Diaphragm Injury
 - ▶ It was previously believed that these were more common on the left side as the liver offers protection on the right; now it is generally accepted that left and right-sided injuries occur with equal frequency
 - ▶ **Blunt trauma** produces **large tears** that lead to **herniation** of abdominal contents, whereas **penetrating trauma** produces **small perforations** that can take time (sometimes years!) to develop into a diaphragmatic hernia
- Cardiac Tamponade
 - ▶ More common in penetrating trauma
 - ▶ Beck's triad: JVD, hypotension, muffled heart sounds
 - ▶ Pulsus paradoxus: drop in systolic BP > 10 with inspiration
 - ▶ Electrical alternans: alternating QRS direction



- ▶ Diagnosis: ultrasound

- ▶ Treatment: fluid bolus, pericardiocentesis

ABDOMINAL / PELVIC TRAUMA

- Liver is the most commonly injured organ in all of abdominal trauma
- Spleen is the most commonly injured organ in blunt abdominal trauma
 - ▶ Kehr's sign = referred pain to left shoulder from splenic rupture
- "Seat belt sign" = ecchymosis over the abdominal wall in distribution of the seat belt should raise suspicion for intra-abdominal injury

Which of the following is the diagnostic modality of choice in hemodynamically unstable patients with blunt abdominal trauma?

- A) CT scan
- B) Ultrasound
- C) Diagnostic peritoneal lavage (DPL)
- D) None of the above

Answer: B

Explanation: Hemodynamically stable patients can undergo CT scan. Bedside ultrasound (FAST exam) should be the initial diagnostic modality in unstable patients to determine the need for laparotomy. DPL can be helpful when physical exam is unreliable and FAST or CT shows minimal fluid. The only absolute contraindication to DPL is an obvious need for laparotomy.

- Disadvantage of DPL: can miss retroperitoneal bleeds
- Positive DPL:

- ▶ 10 mL of blood
- ▶ RBC > 100,000 for blunt trauma
- ▶ RBC > 10,000 for penetrating trauma
- ▶ Presence of bile or feces

Most commonly injured organs in gunshot wounds: small bowel > colon > liver

Most commonly injured organs in stab wounds: liver > small bowel > diaphragm

- Eviscerated organs should never be reduced in the ER as this can worsen the injury - cover the extruded organs completely with sterile gauze and then moisten liberally with sterile saline
- Pancreatic Injury
 - ▶ Have a high index of suspicion after a rapid deceleration injury (as pancreas is displaced against the vertebral column)
 - ▶ Initial imaging is often normal and labs will not be helpful
- In patients with shock or obvious pelvic fracture, do not perform manual manipulation of the pelvis to assess for stability. If fracture is suspected, manipulation should be done only once as it can result in further hemorrhage. A sheet or pelvic binder can stabilize an unstable pelvis – apply it at the level of the greater trochanters of the femur.



If a patient has any of the following, you should have suspicion for a urethral injury:

- 1) Blood at the urethral meatus
- 2) Perineal bruising
- 3) High-riding prostate

Don't place a foley catheter until a retrograde urethrogram has been done to evaluate for urethral injury!

Urethral Injuries

Anterior

Located distal to membranous urethra

Blunt trauma to perineum (straddle injury)

Can have delayed presentation

Can lead to stricture

Posterior

Located in membranous and prostatic urethra

Major blunt trauma (MVA, falls, etc)

Associated with pelvic fractures

Can lead to impotence or incontinence

- Renal Trauma

- ▶ Associated with lower rib fractures and L1-L2 transverse process fractures
- ▶ Can present without hematuria so don't depend on a urinalysis
- Bladder Rupture
 - ▶ Most commonly occurs at the bladder dome
 - ▶ *Gross hematuria is almost 100% sensitive* (absence rules out rupture)
 - ▶ **Intraperitoneal: requires surgical intervention**; posterior dome of bladder ruptured so urine enters peritoneal cavity → **peritonitis**
 - ▶ **Extraperitoneal: more common**; associated with **pelvic fractures** and corrected with placement of a foley catheter

WOUND CARE

- **Tetanus**
 - ▶ The classic triad of symptoms is rigidity (trismus, dysphagia, increased muscle tone), muscle spasms (risus sardonicus, opisthotonus [severe spasm in which the back arches and the head bends back]), and autonomic dysfunction (increased salivation, tachycardia and hypertension alternating with bradycardia and hypotension).
 - ▶ Tetanus prophylaxis should still be given even to those who present late after a laceration as the incubation period can be up to several months
 - ▶ Td or Tdap? Td is preferred for those age 65 years and older, or those who have received a Tdap previously. Tdap is preferred for those who have never received Tdap. Persons with HIV or severe immunodeficiency who have contaminated wounds should also receive immune globulin regardless of their immunization history.
 - ▶ No vaccine for patients 6 weeks of age or younger with clean/minor wounds. If the wound is dirty, administer immune globulin only.

- ▶ **Treatment:** the best and first-line treatment is adequate wound debridement. Tetanus immune globulin, benzodiazepines for spasm control, and antibiotics are also important (metronidazole is now considered first-line, but penicillin G is an acceptable alternative).
- ▶ Most common cause of death: skeletal muscle spasm affecting the respiratory tract

Local anesthetics – what's important?

There are two main types – amides and esters

A very easy way to distinguish between the two: if there are two 'i' in the name, then it's an amide; if there is only one 'i' it's an ester

For instance: Bupivacaine? Amide. Lidocaine? Amide. Procaine? Ester. Hawaii? Amide.

A true immunologic allergic reaction to local anesthetics is extremely rare – most of the time people are allergic to a **methylparaben preservative** rather than the actual medication.

- ▶ Lidocaine
 - ◆ *Maximum dose = 4.5 mg/kg*
 - ◆ *Maximum dose with epinephrine = 7 mg/kg*
- ▶ Bupivacaine (aka 'marcaine')
 - ◆ *Maximum dose = 2 mg/kg*
 - ◆ *Maximum dose with epinephrine = 3 mg/kg*

How long do I typically have to repair a laceration?

About 12 hours for most lacerations, but up to 24 hours for facial/scalp lacerations. There is no agreed upon 'golden period' within which a wound must be closed.

What if the laceration is more than 12 hours old?

The patient can return in **3-5 days** for 'delayed primary closure'; the wound is cleaned and left open until the risk of infection has lowered to the point

where it can be closed. This method of closure is ideal for dirty/contaminated wounds.

- **Stages of repair**
 - ▶ Primary intention = wound closure
 - ▶ Secondary intention = wound is allowed to granulate and close naturally
 - ▶ Tertiary intention = aka 'delayed primary closure'; wound is cleaned and left open for 3-5 days, then closed
- Studies have shown sterile gloves have no benefit in uncomplicated laceration repair. High-pressure irrigation with either tap water or saline has been shown to reduce likelihood of infection. Betadine/iodine solutions are not recommended.
- Pseudomonas can reside in **sneaker soles** - if a person steps on a nail while wearing shoes they should receive antibiotic coverage for **Pseudomonas**
- For scalp wounds, it is essential to ensure the galea aponeurotica is intact prior to closure. Hair should not be shaved prior to suturing as this raises the chance for infection; if necessary, it can be trimmed with scissors. Scalp wound infections can lead to osteomyelitis and brain abscesses.

A 45 year old woman with a history of lupus presents to the ER for vomiting, diarrhea, and muscle aches. Her only medication is prednisone. She remembers being bitten by a cat two weeks ago. Which of the following organisms should be suspected?

- A) Capnocytophaga
- B) Salmonella
- C) Pasteurella
- D) Eikenella

Answer: A

Explanation: Capnocytophaga is transmitted most often by cats or dogs. It can occur by bites, licks (!), or even just by being in close proximity to them. It is more common in immunosuppressed patients, as well as alcoholics and those who are asplenic. Symptoms can occur up to four weeks later and range from mild to full-blown sepsis.

To take the question one step further, what is the treatment of choice?

- A) Amoxicillin
- B) Amoxicillin-clavulanate
- C) Penicillin G
- D) Cephalexin

Answer: C

Explanation: Penicillin G is the treatment of choice for Capnocytophaga infections and antibiotics should be prescribed for three weeks.

- Human bite? Think Eikenella
- Cat bite? Think Pasteurella
- Dog bite? Think Pasteurella
- Sepsis in immunosuppressed or asplenic patient? Think Capnocytophaga
- Reptile bite? Think Salmonella

Should wounds from animal bites be sutured or left open?

There's no black or white answer to this. In general, most cat or human bites should be left open to heal by secondary intention. If cosmesis is important (such as a facial laceration), then even cat or human bites might be loosely closed. On the contrary, dog bites are generally closed with sutures. Exceptions to this are dog bites to the hands or feet. To summarize: wounds at high risk of infection that should not be closed primarily:

Crush injuries Puncture wounds

Bites involving the hands or feet
Cat or human bites (except those on the face)
Wounds more than 12 hours old (24 hours on the face)
Bites in immunocompromised hosts

- Rabies
 - ▶ **Most important initial step is wound care** – wash with soap and water
 - ▶ Post-exposure prophylaxis should be given as early as possible and is never too late, unless clinical signs of rabies are seen
 - ▶ Rabies vaccine
 - ◆ Always use the deltoid if possible; avoid the gluteus
 - ◆ Given on days 0, 3, 7, and 14 (also on day 28 in immunosuppressed)
 - ◆ If day 3 is missed, for instance, administer a dose now and then in four and again in eleven days (as if the today was the due day)
 - ▶ Post-exposure prophylaxis rabies immunoglobulin
 - ◆ As much as anatomically feasible should be given in and around the wound, remainder should be given IM at a site different from where the vaccine is given
 - ◆ If there is no wound (exposure to bats for instance) give the immunoglobulin in the gluteus
- **Necrotizing Fasciitis** is a rare but **rapidly progressive and fatal** bacterial infection. Patients will often present with soft tissue swelling and pain near a site of trauma. **Pain** may be out of proportion to exam and is the earliest finding. Fever, systemic signs of illness, brawny edema, induration, and crepitus can follow. X-rays can show **subcutaneous emphysema** (since there may be gas-producing organisms involved) and MRI can aid in diagnosis. Cultures should be obtained: the most common isolates are **MRSA and S. pyogenes**. Treatment should not be delayed for imaging/labs! **Antibiotics should include coverage for gram positive (penicillin or cephalosporin), gram negative (aminoglycoside or ciprofloxacin), and anaerobes (clindamycin or metronidazole).** **Early surgical consultation** is

essential.

- ▶ Type 1 = polymicrobial infection ie mixed aerobic and anaerobic
- ▶ Type 2 = *S. pyogenes*
- ▶ Type 3 = Clostridial myonecrosis aka gas gangrene

MISCELLANEOUS

- Air Embolism
 - ▶ Occurs after air enters the arterial or venous circulation
 - ▶ Central line placement is the most common cause in the ED
 - ▶ Most patients have nonspecific symptoms; consider in any patient with sudden onset hypoxia, hemodynamic collapse, or loss of consciousness
 - ▶ Treatment: high-flow 100% oxygen
 - ◆ Place in the left lateral decubitus and Trendelenburg position
 - ◆ Arterial: *do not* place patient with head down; keep flat and supine
 - ▶ Prevention: proper positioning during the procedure
- ASA classification for airway assessment
 - ▶ I : normal healthy patient
 - ▶ II : patient with mild systemic disease
 - ▶ III : patient with severe systemic disease
 - ▶ IV : patient with severe systemic disease that is a constant threat to life
 - ▶ V : moribund patient who is not expected to survive the procedure
 - ▶ Class III and IV require consultation with an anesthesiologist

Paramedics are performing chest compressions on an unresponsive patient. They were unable to establish an IV but have an endotracheal tube in place. Which of the following medications can safely be given to the patient while alternative plans are being made for IV access?

- A) Succinylcholine
- B) Naloxone
- C) Amiodarone
- D) Valium
- E) Etomidate

Answer: B

Explanation: The mnemonic used to be 'NAVEL', which stands for **n**aloxone, **a**trypine, **v**alium, **e**pinephrine, and **l**idocaine. More recent evidence has shown that valium is no longer recommended via the endotracheal route.

- Morphine causes histamine release and can therefore cause hypotension and bronchospasm. Since fentanyl is a synthetic opioid, it does not release histamine and is therefore not associated with hypotension.
- Fentanyl can cause chest wall rigidity when administered too rapidly. Treatment is naloxone. Consider RSI drugs and intubation.
- Ketamine
 - ▶ When administered IV, onset is 1 minute and duration is 5-10 minutes
 - ▶ Low-dose ketamine (0.1-0.3mg/kg) can be used for analgesia
 - ▶ Full-dose (1-2mg/kg IV or 4-5mg/kg IM) is a dissociative anesthetic dose
 - ▶ Has been shown to worsen psychosis in some patients and is contraindicated in those with schizophrenia. It is used frequently as a sedative for the agitated delirious patient however.
 - ▶ Can rarely cause emergence reactions (vivid dreams, hallucinations, etc) in adult patients or those with psychosis: treat with benzodiazepines
 - ▶ **Can cause laryngospasm (rare): consider this if, during RSI, the patient develops sudden onset inspiratory stridor and apnea. Treatment is bag-valve mask and it will resolve.**



1. A patient presents with a laceration to the left lower extremity that crosses the knee joint. Presence of which of the following warrants operative evaluation?
 - A) Diminished pulse
 - B) Hypotension that responds to IV fluids
 - C) Expanding hematoma
 - D) Continued bleeding despite laceration repair

Answer: C

Diagnosis of vascular injury is suggested when 'hard signs' of vascular trauma are present: pulsatile bleeding, expanding hematoma, absent pulses, palpable thrill, or a cold/pale limb. Presence of 'hard signs' is an indication for operative evaluation. If hard signs are absent but clinical suspicion remains high, angiography can be done.

2. A young man is involved in a motorcycle crash. Blood is found at the urethral meatus. Which test is needed prior to placing a foley catheter?
 - A) CT of the abdomen/pelvis
 - B) Cystoscopy
 - C) Urethrogram
 - D) Cystogram

Answer: C

Urethral trauma is suggested by finding blood at the urethral meatus, gross hematuria, or a high-riding prostate on rectal exam. In such patients, a retrograde urethrogram should be done prior to insertion of a foley catheter.

3. Two men get into a fight over which pony they think is the cutest and one of them gets punched in the face. He presents with a sunken eye

and decreased sensation on his upper cheek. While checking extraocular movements, you ask him to look up and he reports double vision. Which of the following muscles is most likely involved?

- A) Superior rectus
- B) Inferior rectus
- C) Superior oblique
- D) Medial rectus

Answer: B

The patient has suffered an orbital floor fracture. The inferior rectus and inferior oblique muscles run along the floor of the orbit and can become entrapped. Restriction of these muscles leads to diplopia on upward gaze.

4. A 50 year old female complains of pain and swelling along her left lower jaw. The pain worsens while eating. She constantly has a dry mouth despite drinking plenty of fluids. Which treatment is most likely to provide relief?

- A) Incision and drainage
- B) Oral antibiotics
- C) Sialogogues
- D) IV antibiotics
- E) NSAIDs and reassurance

Answer: C

Salivary stones are most often found in the submandibular location of a salivary duct. Patients often have a dry mouth with pain and swelling that worsens during mealtime. Sour candy such as lemon drops (sialogogues) increase salivation and facilitate passage of stones. Incision and drainage may ultimately be necessary but is not considered first-line treatment. Oral antibiotics may be used in certain cases.

5. Which of the following statements is true regarding compartment syndrome in a patient with a tibia fracture?
- A) Presence of an open wound rules out compartment syndrome
 - B) Intra-compartmental pressure > 20 mm/Hg is considered diagnostic
 - C) Management includes elevating the affected leg above the level of the heart
 - D) Compartment syndrome can occur at lower pressures in hypotensive patients

Answer: D

Presence of an open wound does not rule out a diagnosis of compartment syndrome. Pressures > 30 mm/Hg are considered diagnostic but may be lower if the patient is hypotensive. The affected limb can be elevated to the level of the heart but should not be kept above it as this can restrict arterial flow.

6. Which of the following is true regarding rhabdomyolysis?
- A) Most patients will report weakness
 - B) Myoglobin is almost universally present in the urine
 - C) Myoglobin has a long half-life and will remain elevated for 12-24 hours
 - D) Excessive fluid resuscitation may result in compartment syndrome

Answer: D

Less than half of patients will report muscular symptoms and most will not report weakness. Serum CK has a long half-life and will usually be more than 5x the upper limits of normal. Myoglobin on the other hand has a half-life of only 2-3 hours and levels will return to normal within 6-8 hours.

Hyperkalemia and hyperphosphatemia result from the release of potassium and phosphorus from damaged muscle cells. Compartment syndrome may develop after fluid resuscitation.

7. A newborn has a heart rate of 126/min with irregular respirations. He has flexion of all four extremities and resists extension. He grimaces in response to stimulation but does not cry or pull away. Hands and feet are cyanotic but otherwise he is pink in color. What is this newborn's APGAR score?

- A) 6
- B) 7
- C) 8
- D) 9
- E) 10

Answer: B

	0 (Points)	1	2
Appearance	Blue or pale all over	Blue extremities, but torso pink	Pink all over
Pulse	None	< 100	≥ 100
Grimace	No response	Weak grimace when stimulated	Cries or pulls away when stimulated
Activity	None	Some flexion of arms	Arms flexed, legs resist extension
Respirations	None	Weak, irregular or gasping	Strong cry

Appearance: 1 (hands and feet are cyanotic)

Pulse: 2 (>100)

Grimace: 1 (does not cry or pull away)

Activity: 2 (resists extension)

Respirations: 1 (irregular)

8. A new type of rapid HIV test is being developed. In a sample of 100 patients, 70 are known to be HIV positive and 30 are known to be negative. 60 of the patients with HIV tested positive using this new tool and the other 10 tested negative. 15 patients who do not have HIV

tested positive. What is the specificity of this new rapid HIV test?

- A) 0.33
- B) 0.5
- C) 0.66
- D) 0.75

Answer: B

Sensitivity reveals what percent of patients who have a condition will have a positive result (TP/TP+FN). Specificity, on the other hand, is the measure of a test's ability to correctly identify those without disease. In other words, it is the true negative rate (TN/TN+FP). In this example, 15 patients are known to be negative but 15 of them tested positive: $15/30 = 0.5$.

9. A child was playing outside when his neighbor's dog bit him on the leg. He has a 1 cm gaping laceration to his lower leg. The dog is up to date on rabies vaccination. What is the best course of action?

- A) Wash the wound with soap and water
- B) Irrigate the wound with saline
- C) Apply antibiotic ointment and gauze dressing
- D) Apply gauze dressing and discharge home with oral antibiotics

Answer: A

These are the types of questions they love to ask: of course you would wash the wound with soap/water *and* irrigate with saline *and* apply antibacterial ointment. But what's the *best* course of action? The best initial step is to wash with soap and water. Oral antibiotics are not indicated in routine animal bites but should be considered in high-risk cases (dirty wounds, lacerations to the feet or hands, etc).

10. A 30 year old male is stabbed in the chest. Which of the following is

true regarding diaphragmatic rupture?

- A) The right hemidiaphragm is more commonly affected
- B) Penetrating trauma leading to rupture may present years later
- C) Penetrating trauma produces large lesions which can cause herniation of abdominal wall contents into the chest
- D) The liver is the most frequently herniated organ

Answer: B

The liver offers protection on the right side so most diaphragmatic injuries occur on the left side. Blunt trauma tends to produce large tears that can lead to herniation of abdominal contents into the chest while penetrating trauma produces small tears that can take years to develop. The stomach is the most frequently herniated organ.

11. Which of the following statements is true regarding inpatient treatment of community acquired pneumonia?

- A) Blood cultures should be sent for all cases
- B) Initiating antibiotics within four hours reduces morbidity
- C) Infection occurring within 120 days of hospitalization is known as 'healthcare associated pneumonia'
- D) Pneumonia mortality rates have not changed significantly since penicillin became readily available

Answer: D

Blood cultures are not necessary in routine cases of community-acquired pneumonia. Initiating antibiotics within four hours has not shown any effect on morbidity or mortality. Healthcare-associated pneumonia was defined as infection occurring within 90 days of a hospitalization; this term is no longer used.

12. A 65 year old disheveled man presents with fractures in different stages of healing. He confirms that his family abuses him but he wishes to return home with them. In addition to notifying adult protective services, what should be done?

- A) Admission to the hospital
- B) Placement in a shelter
- C) Nursing home placement
- D) Discharge home with family

Answer: D

Elder abuse is a mandatory reportable offense. In 90% of cases, the perpetrator is a family member. Women and 'older elders' are more likely to be affected. Although reporting is mandatory, persons with capacity have a right to make their own decision regarding placement.

13. A 70 year old male presents with foot pain. On exam his foot is cold and pulseless. What is the most likely cause?

- A) Thromboembolism
- B) Arterial thrombosis
- C) Trauma
- D) Hyperlipidemia

Answer: A

The most common cause of acute ischemia in an extremity is a thromboembolism of cardiac origin.

14. Which of the following represents the correct order of sequence for appearance of sonographic findings of an intrauterine pregnancy?

- A) Gestational sac, fetal pole, double decidual sign, fetal heart activity

- B) Double decidual sign, gestational sac, yolk sac, fetal pole, fetal heart activity
- C) Gestational sac, double decidual sign, yolk sac, fetal pole, fetal heart activity
- D) Gestational sac, yolk sac, double decidual sign, fetal pole, fetal heart activity

Answer: C

Presence of a gestational sac is the earliest finding while presence of the double decidual sign is considered the earliest evidence of an intrauterine pregnancy. Unfortunately the double decidual sign is only seen in about 50% of pregnancies. The yolk sac is the first structure seen inside the gestational sac. Cardiac activity should be detected by approximately six weeks.

15. Which of the following statements is true regarding tularemia?

- A) Patients should be placed in isolation with contact precautions
- B) The ulceroglandular variant of tularemia is most common
- C) Presence of a high fever should raise suspicion for another unrelated condition
- D) Treatment of choice is doxycycline

Answer: B

Tularemia can be transmitted in a variety of ways: handling of sick animals, inhaling dust particles, drinking contaminated water, and through tick bites. Symptoms depend on the method of transmission but the presence of fever is almost universal. The ulceroglandular form is most common and is characterized by the presence of a skin ulcer which develops at the site of entry along with regional lymphadenopathy. This form is associated with tick bites. When ingested or inhaled, patients may develop oropharyngeal or pneumonic variants of tularemia. There is no human to human transmission

so isolation in the hospital is unnecessary. The treatment of choice is streptomycin for ten days.

16. Ultrasound is more sensitive than plain films for which type of fracture?

- A) Rib
- B) Femur
- C) Tibial plateau
- D) Scaphoid

Answer: A

Plain films may miss up to 50% of rib fractures, even with dedicated rib series. Ultrasound may demonstrate cortical discontinuity, linear edge shadow, and acoustic reverberation artifacts - and has been found to be more sensitive than radiographs in cases of rib and sternal fractures.

17. You are planning to perform procedural sedation for a child with a laceration. The patient's last meal was two hours ago. How much additional time should you wait to perform the sedation?

- A) 2 hours
- B) 4 hours
- C) 6 hours
- D) No amount of time is necessary

Answer: D

Risk of emesis and subsequent aspiration has not been found to be associated with duration of fasting. Therefore there is *no* need to delay procedural sedation in either adults or pediatric patients based on fasting time.

18. Which of the following is true regarding brown recluse spider envenomations?

- A) Dapsone may be beneficial in preventing local effects of the venom
- B) Fatalities are more common in the elderly than in children
- C) Tetanus prophylaxis is not indicated in routine bites
- D) Wound infection is common and antibiotics should be routinely administered

Answer: A

Wound infection is rare following a brown recluse spider bite; therefore, antibiotics are not routinely recommended. Tetanus prophylaxis is indicated in all cases. Fatalities are more common in children.

19. Which of the following contributes to the development of hepatic encephalopathy in a patient with cirrhosis?

- A) Acidosis
- B) Hyperkalemia
- C) Hypokalemia
- D) Hyperglycemia
- E) Volume overload

Answer: C

Hypokalemia contributes to increased ammonia production/absorption and can precipitate hepatic encephalopathy. Alkalosis, dehydration, and hypoglycemia may do the same.

20. Which of the following statements is true regarding treatment of COPD?

- A) Administering steroids intravenously has been shown to increase

- hospital length stays without reducing morbidity or mortality
- B) Use of ipratropium is contraindicated in pregnancy
 - C) Antibiotics are indicated for any patient who presents to the ER with wheezing
 - D) Sputum cultures should be done on patients with productive cough

Answer: A

Studies have shown that administering steroids orally is the preferred method as it can reduce hospital stays and *may* in turn actually reduce morbidity. None of the medications routinely given for asthma or COPD are contraindicated in pregnancy. Antibiotics should be given to patients with a change in quantity or character of their sputum, and sputum cultures on patients with routine COPD exacerbations are not recommended.

21. A cardiac pacemaker has the identification code 'DDIRD'. Which of the following statements is true?
- A) The first letter refers to the chamber paced
 - B) The second letter refers to the chamber paced
 - C) The first letter refers to the chamber sensed
 - D) The third letter refers to the chamber sensed

Answer: A

The first letter refers to the chamber paced, second letter chamber sensed, third letter response to sensing, fourth letter rate programmable functions, and the fifth letter refers to special tachyarrhythmic functions.

22. A 16 year old girl dislocates her patella while playing volleyball. Which of the following is true?
- A) Patellar dislocations are most often medial
 - B) After reduction, she should use a knee immobilizer to keep her

- knee in a flexed position
- C) Post-reduction films are unnecessary unless an associated injury is suspected
 - D) She is at high risk to have recurrent dislocation

Answer: D

Patellar dislocations are typically lateral and the mechanism is usually a direct blow to the anterior or medial surface of the patella. Post-reduction films should always be obtained to evaluate for avulsion fractures and other associated injuries. After successful reduction, the knee should be immobilized in full extension and almost half of all patients will have a recurrent dislocation.

23. Which of the following statements is true regarding airway management of an obese patient?

- A) Airway resistance is decreased in obesity
- B) Pulse oximetry measured on the fingers is equally accurate despite increased soft tissue and thickness of the fingers
- C) Obese patients have higher pH of gastric contents
- D) Obese patients take longer to desaturate
- E) Ideal positioning is to elevate the head 25 degrees

Answer: E

Obese patients may undergo oxygen desaturation within 3 minutes compared to 6 minutes in normal weight patients. Obese patients have a higher incidence of GERD and have lower gastric pH which puts them at risk for lung injury after aspiration. In the morbidly obese patient, the head and shoulders should be elevated above the chest – this will improve laryngoscopic view over the standard ‘sniff’ position in obese patients. It may also improve mask ventilation and provide easy access to the neck for application of cricoid pressure and attempts at surgical airways.

24. A pregnant female is being treated for eclampsia with IV magnesium sulfate. She becomes bradypneic and less responsive. Which of the following should be administered?

- A) Bicarbonate
- B) Calcium gluconate
- C) Magnesium sulfate
- D) Phosphate

Answer: B

Calcium gluconate will reverse the effects of hypermagnesemia.

25. Which of the following is an indication for admission in patients with hepatitis?

- A) INR > 1.5
- B) Hypoglycemia
- C) Total bilirubin > 30
- D) Encephalopathy
- E) All of the above

Answer: E

Indications for hospitalization in patients with hepatitis include presence of encephalopathy, hypoglycemia, PT > 3 seconds or INR > 1.5, or a bilirubin level > 30.

26. A patient presents with abdominal pain. KUB is shown below. Which of the following statements is true regarding this finding?



- A) Urine will likely test positive for calcium oxalate crystals
- B) The presence of fever and jaundice can confirm the diagnosis
- C) This patient has a higher risk of appendiceal perforation
- D) Optimal treatment includes placement of a nasogastric tube and bowel rest
- E) Ranson's criteria are of little prognostic value in the first 24 hours

Answer: C

Appendicoliths are present in up to 30% of children with acute appendicitis and are associated with a higher risk of perforation. They may be an incidental finding on plain film or CT scan and their exact significance is unknown. In the presence of abdominal pain, their presence should raise concern for acute appendicitis.

27. An elderly male patient presents with weakness. He recently started chemotherapy for squamous cell lung cancer. Labs show acute renal failure and hyperkalemia. Which of the following is also most likely present?

- A) Hyponatremia
- B) Hypocalcemia
- C) Hypophosphatemia
- D) Hypoglycemia

Answer: B

Expected findings in cases of tumor lysis syndrome include hyperkalemia, hyperuricemia, hyperphosphatemia, and hypocalcemia.

28. A 6 day old infant presents to the ER with watery eye drainage. Which of the following is the best course of action?

- A) Send a culture and discharge home with close outpatient follow-up
- B) Treat with topical erythromycin 0.5% ointment
- C) Treat with topical erythromycin 0.5% ointment and oral erythromycin
- D) Administer ceftriaxone 50mg/kg IV and admit to the hospital
- E) Reassure the parents; this is likely a reaction to silver nitrate

Answer: C

Conjunctivitis occurring in the first 2-4 days of life is most consistent with non-infectious chemical conjunctivitis. Historically it was most often due to topical silver nitrate and for this reason erythromycin is now often administered instead. Gonococcal conjunctivitis typically presents within the first five days of life and is associated with bilateral purulent drainage. Chlamydia trachomatis produces conjunctivitis after day three and up to two weeks after delivery. Discharge is typically watery and neonates are also at risk to develop pneumonia. Treatment consists of topical and oral

erythromycin and both parents should also be treated.

29. A 45 year old male presents with thoracic back pain and symmetric weakness in both legs. The following image is obtained. Which of the following is true?



- A) Antibiotics should be started with a focus on coverage for *S. aureus*
- B) Neurosurgical consultation should be obtained immediately
- C) Most patients can be managed with supportive care
- D) Lumbar puncture is contraindicated
- E) Patients often have skin findings of focal erythema and warmth

Answer: C

Images show a lesion consistent with transverse myelitis. This is an acute or subacute inflammatory disorder of the spinal cord. Presentation can be variable but most patients complain of focal neck or back pain, sensory loss, and paraplegic symmetric motor weakness. Causes range from postinfectious (EBV and CMV most commonly), multiple sclerosis, lupus, or cancer. If no

cause is found, transverse myelitis may be idiopathic. MRI best establishes the diagnosis by demonstrating high-intensity signals on T2-weighted images. Lumbar puncture can reveal lymphocytosis and elevated protein and can help narrow the differential diagnosis. When suspected in the ER, admission for further workup is warranted. Treatment for transverse myelitis is mostly supportive.

30. Which of the following illnesses does not require strict airborne precautions?

- A) Measles
- B) Tuberculosis
- C) Anthrax
- D) Smallpox

Answer: C

Inhalational anthrax has no human to human transmission so airborne precautions are unnecessary. Interestingly, meningococcal meningitis is also not spread airborne and requires droplet precautions only.

31. What is the most likely diagnosis in a father and son who present together with abdominal pain, flushing, and pruritis after eating at a restaurant?

- A) *S. aureus*
- B) Scombroid poisoning
- C) *Clostridium*
- D) Ciguatera poisoning
- E) Hereditary angioedema

Answer: B

Ciguatoxin characteristically causes GI symptoms and neurological

complaints such as paresthesias and hot/cold reversal. Scromboid toxicity presents with a histamine- like reaction.

32. A 48 year old man dislocates his hip while dancing along to his favorite Irish rock band. Which of the following is true regarding hip dislocations?
- A) Posterior dislocation leads to shortening and abduction
 - B) Prolonged duration of dislocation is not associated with risk of developing avascular necrosis
 - C) Anterior dislocation leads to shortening and external rotation
 - D) Anterior hip dislocations are more common than posterior

Answer: C

Posterior hip dislocations are more common (for instance when the knee strikes the dashboard in a motor vehicle accident). This produces a shortened, internally rotated, adducted extremity. Anterior dislocations on the other hand yield a shortened and externally rotated extremity. The longer the period of time from when the hip is dislocated to when it is reduced, the higher the risk of developing avascular necrosis.

33. Which of the following statements is true regarding infection in solid organ transplant recipients?
- A) Trimethoprim-sulfamethoxazole should not be used as prophylaxis against pneumocystis pneumonia
 - B) Opportunistic infections occur most frequently in the first month after transplantation
 - C) CMV can cause invasive disease that produces fever and neutropenia
 - D) All of the above are true

Answer: C

Most transplant patients use trimethoprim-sulfamethoxazole as prophylaxis for pneumocystis pneumonia and toxoplasmosis (amongst others).

Opportunistic infections are generally absent during the first month after transplantation, since the full effect of immunosuppression is not yet present. CMV may cause invasive disease characterized by fever, weakness, myalgia, and myelosuppression.

34. Which of the following statements is true regarding ultrasound findings of foreign bodies?

- A) Foreign bodies are usually hypoechoic relative to surrounding soft tissue
- B) Wooden foreign bodies are often associated with comet tail artifact
- C) Foreign bodies will typically be hyperechoic while scar tissue is hypoechoic, making the two relatively easy to distinguish
- D) Wooden foreign bodies have a characteristic acoustic shadow similar to a gallstone

Answer: D

Gravel and wood have a characteristic acoustic shadow similar to a gallstone. Metallic objects frequently display a comet tail in which bright regularly spaced parallel lines are seen distal to the foreign body. Both scar tissue and foreign bodies appear hyperechoic relative to surrounding tissues, making it difficult to distinguish between the two. Foreign bodies retained for longer than 24 to 48 hours are frequently surrounded by a halo, resulting from reactive hyperemia, edema, abscess, or granulation tissue.

35. Which of the following statements is true regarding gamma-hydroxybutyrate (GHB) intoxication?

- A) Patients who use this drug chronically do not experience withdrawal symptoms if use is abruptly stopped

- B) GHB is detected on most urine toxicology tests
- C) Periods of agitation alternating with periods of depressed level of consciousness is characteristic
- D) Toxicity is not exacerbated by co-ingestion of alcohol

Answer: C

A unique feature of GHB intoxication is an alternating respiratory depression and agitation, with flailing activity described similar to a drowning swimmer fighting for air. It is not detected on most urine toxicology screens. Patients who stop GHB use acutely after chronic use may experience a severe and potentially life-threatening withdrawal syndrome. Toxicity is increased if taken with alcohol or other CNS depressants.

36. Which of the following statements is true regarding burn management?

- A) Calculations of body surface area should not include first-degree burns
- B) In the early stage of inhalational injury, *S. aureus* is the most common cause of pneumonia
- C) Pediatric patients suffer more extensive damage during inhalational injuries due to their smaller airways
- D) All of the above are true

Answer: D

In the early stages of inhalational injury, *S. aureus* is the most common cause of pneumonia. Later, *Pseudomonas* predominates. In such instances, pediatric patients suffer greater damage due to relatively higher minute ventilations and smaller airways.

37. How should a child with Rocky Mountain Spotted Fever be treated?

- A) Doxycycline
- B) Chloramphenicol
- C) Trimethoprim/Sulfamethoxazole
- D) Ciprofloxacin

Answer: A

Doxycycline should be given for 7-14 days to children with Rocky Mountain Spotted Fever. The recommended dosage does not cause permanent tooth discoloration.

38. Routine treatment of rhabdomyolysis should include which of the following?

- A) Loop diuretics
- B) IV fluid resuscitation
- C) Osmotic diuretics
- D) All of the above

Answer: B

The cornerstone of therapy for rhabdomyolysis is fluid resuscitation. There is no clinical benefit with loop diuretics (such as furosemide) or osmotic diuretics (such as mannitol). Furthermore, patients may initially have low calcium levels which will rise with fluid resuscitation – administering calcium may cause overshoot and symptoms of hypercalcemia. Calcium use should be reserved for those with hyperkalemia.

39. In what setting is allopurinol contraindicated for treatment of gout?

- A) Presence of renal insufficiency
- B) Polyarticular involvement
- C) Alcoholic patient
- D) Monotherapy during an acute flare

Answer: D

Allopurinol should not be used as *monotherapy* for acute exacerbations of gout. The American College of Rheumatology recommends allopurinol as a first-line treatment even for acute exacerbations but only so long as appropriate anti-inflammatory medications are co-administered (NSAIDs or corticosteroids).

40. Which of the following can be used as treatment for *Haemophilus ducreyi*?

- A) Azithromycin 1 gram PO
- B) Penicillin 1.2 million units IM
- C) Doxycycline 100mg PO BID for seven days
- D) Amoxicillin 875mg PO BID for seven days

Answer: A

H. ducreyi is a gram negative infection that can be treated with azithromycin 1 gram PO, ceftriaxone 250mg IM, or ciprofloxacin.

41. Which of the following statements is correct regarding patients with eye pain?

- A) There are no reports of tetanus being acquired through corneal abrasions so there is no indication to update a patient's tetanus status
- B) UV keratitis typically causes pain beginning almost immediately after exposure to bright light
- C) Patients with iritis may have a misshapen pupil
- D) Central retinal venous occlusion is considered an emergency

Answer: C

While there are no reports of tetanus ever having been acquired through corneal abrasion, it is considered standard of practice to update tetanus status. UV keratitis has a delayed onset of 6-12 hours between the time of exposure and onset of symptoms. Iritis can cause a pupil to become constricted and/or misshapen.

42. Which of the following statements is true regarding intracranial bleeds?

- A) An elevated blood sugar level does not correlate with worse outcomes
- B) Hyperventilation raises cerebral blood flow
- C) Subdural hemorrhage has a higher rate of mortality than epidural hemorrhage
- D) Labetolol is the antihypertensive of choice in subarachnoid hemorrhage

Answer: C

Hyperglycemia has been linked to poorer outcomes in patients with ICH – as has hypoxia, hypotension, and hypertension. Nicardipine is the antihypertensive agent of choice in subarachnoid hemorrhage. Subdurals have a higher mortality rate than epidurals.

43. What is the earliest EKG finding of acute myocardial ischemia?

- A) ST elevation
- B) Q waves
- C) Peaked T waves
- D) ST depression

Answer: C

Earliest changes following coronary artery occlusion are an increase in T wave height, followed by ST elevation. Q waves and T wave inversions occur later.

44. Which of the following statements is true regarding pertussis?

- A) The incubation period for B. pertussis is 2-3 days
- B) 90% of cases occur in children
- C) Penicillin or cephalosporins are the antibiotics of choice
- D) Antibiotics may be of benefit even after four weeks of symptoms

Answer: D

There are three phases of pertussis: the catarrhal, paroxysmal, and convalescent.

The incubation period for pertussis is relatively long at 7-10 days – therefore exposure to a person with a cough 1 to 2 weeks prior to the development of symptoms is suggestive of pertussis. About half of all cases occur in adolescents and adults. Antibiotics are effective only if administered in the catarrhal phase. However, they are recommended to help reduce spread of infection so should be routinely given. Macrolides are the agent of choice (azithromycin, erythromycin).

45. How many adjacent ribs must be broken to make a diagnosis of ‘flail chest’?

- A) 2
- B) 3
- C) 4
- D) 5

Answer: B

At least three adjacent ribs must be broken in two or more spots in order to

make a diagnosis of flail chest. Be wary of associated pulmonary contusions, in which patients can initially appear benign but may rapidly decompensate.

46. What is the most common cause of acute chest syndrome in patients with sickle cell disease?

- A) *S. pneumoniae*
- B) *S. aureus*
- C) *Klebsiella*
- D) *M. pneumoniae*

Answer: D

C. pneumoniae and *M. pneumoniae* are the leading infectious agents that cause acute chest syndrome.

47. In an unstable patient with cardiac tamponade, which of the following chambers is being compressed during diastole?

- A) Right ventricle
- B) Right atrium
- C) Left ventricle
- D) Left atrium

Answer: A

In the presence of pericardial tamponade, during inspiration the negative intra- thoracic pressure causes increased pressure in the right ventricle. This causes the interventricular septum to bulge towards the left ventricle, leading to decreased filling of the left ventricle. At the same time, right ventricular volume is markedly diminished and the right ventricle can collapse.

48. A 60 year old male who works as a cropduster is brought to the ER with weakness and muscle fasciculations. On exam, you notice miosis, bradycardia, and wheezing bilaterally. Treatment for the patient's weakness and fasciculations includes which of the following?

- A) Pralidoxime
- B) Physostigmine
- C) Sodium bicarbonate
- D) Atropine
- E) Lorazepam

Answer: A

This patient is suffering from cholinergic toxicity. Atropine should be given initially to reduce the muscarinic effects and should be continued until bronchoconstriction has ceased and secretions dry up. **Tachycardia and mydriasis cannot be used as indicators of adequate atropine administration.** Since atropine does not bind to nicotinic receptors, it is ineffective at treating neuromuscular dysfunction. Pralidoxime is used to reactivate the acetylcholinesterase enzyme and can reverse muscle paralysis and fasciculations.

49. A 32 year old woman is involved in a motor vehicle accident. She winces and withdraws in response to pain but does not open her eyes. She is making sounds but you cannot make out distinct words. What is her Glasgow Coma Scale score?

- A) 4
- B) 5
- C) 6
- D) 7

Answer: D

GCS is used as a measure of neurologic function in patients with traumatic head injuries. Scores range from 3-15 and are summarized in the table below.

Eye Opening Response	Verbal Response	Motor Response
4 = Spontaneous	5 = Oriented	6 = Obeys commands
3 = To verbal stimuli	4 = Confused	5 = Localizes pain
2 = To pain	3 = Inappropriate words	4 = Withdraws from pain
1 = None	2 = Incoherent	3 = Flexion to pain or decorticate
	1 = None	2 = Extension to pain or decerebrate
		1 = None

50. Which of the following statements is true regarding aspiration pneumonia?

- A) Antibiotics should be started if there is any suspicion of aspiration
- B) Sputum cultures have high sensitivity and can help guide antibiotic selection
- C) Corticosteroids are of no benefit
- D) Unlike other types of pneumonia, a negative x-ray reliably excludes aspiration pneumonia

Answer: C

Prophylactic antibiotics for aspiration are mostly reserved for those who are severely ill upon initial clinical presentation – they should not be used in all cases of aspiration. Sputum cultures have very little clinical utility due to high rates of contamination. Corticosteroids do not reduce morbidity or mortality rates and x-rays can often lag behind: a negative x-ray cannot be used to rule out aspiration.

51. A one-week old neonate has a blood glucose of 30. What is the correct replacement fluid?

- A) D50 1mL/kg
- B) D25 2mL/kg
- C) D10 4mL/kg
- D) D5 10mL/kg

Answer: C

D10 is used in the treatment of hypoglycemia in neonates. D25 is used in pediatric patients and D50 is used in adults.

52. Which of the following is the primary ketone body responsible for acidosis in alcoholic ketoacidosis?

- A) Acetate
- B) Acetoacetate
- C) Beta-hydroxybutyrate
- D) Acetone

Answer: C

Beta-hydroxybutyrate increases to a greater extent than other ketone bodies. Urinalysis typically only detects acetoacetate and may be falsely negative – therefore serum ketone levels are often checked if either alcoholic or diabetic ketoacidosis is suspected.

53. A 65 year old diabetic patient presents with toe pain. On exam he has an ulcer on the base of his first metatarsal. X-rays are done; what is the next best step?



- A) IV antibiotics and emergent surgical consultation
- B) IV antibiotics and admission for blood sugar management
- C) IV antibiotics and labs/cultures – if negative, discharge home
- D) Orthopedic surgery consultation

Answer: A

This patient has gas gangrene caused by *C. perfringens*. Treatment involves debridement and IV antibiotics. Amputation is sometimes necessary and hyperbaric oxygen may be of benefit.

54. Which of the following statements is true regarding moderate sedation?
- A) Mask ventilation is needed to maintain respirations
 - B) Reversal agents are frequently needed afterward
 - C) Patients are unconscious or in a state of depressed consciousness such that they cannot respond purposefully to verbal stimuli
 - D) Airway protective reflexes are maintained

Answer: D

Patients who receive moderate sedation characteristically maintain a patent airway and airway reflexes. Deep sedation involves loss of these reflexes and the establishment of a depressed or lost state of consciousness.

55. Fetal cardiac activity can first be detected by transvaginal ultrasound at what gestational age?

- A) 4 weeks
- B) 5 weeks
- C) 6 weeks
- D) 7 weeks

Answer: C

Fetal cardiac activity can first be seen by transvaginal ultrasound at 5.5-6 weeks.

56. What is the most common cause of pneumonia in patients with HIV?

- A) *P. carinii*
- B) *S. aureus*
- C) *S. pneumoniae*
- D) *P. jirovecii*

Answer: C

P. jirovecii (previously *P. carinii*) is the most common opportunistic infection in HIV patients. Overall, *S. pneumoniae* remains the most common cause of pneumonia.

57. A patient slips and cuts himself on a metal fence post. Two weeks

later, the wound is slow to heal, he has difficulty swallowing, and muscle spasms. Tetanus is suspected; what is the preferred antibiotic to be initiated?

- A) Metronidazole
- B) Clindamycin
- C) Amoxicillin-clavulanate
- D) Doxycycline

Answer: A

Adequate wound debridement is the first and best method of treatment for tetanus. Although antibiotics play a relatively minor role in management, they are still recommended. Metronidazole is now the preferred agent of choice, but penicillin G is an acceptable alternative.

58. What is the expected urine output of a patient with severe hypothermia?

- A) Decreased
- B) Increased
- C) Unchanged
- D) No urine output

Answer: B

Cold diuresis is a phenomenon that occurs after exposure to a hypothermic environment, usually during mild to moderate hypothermia. It is thought to be due to a redirection of blood from the extremities to the core due to vasoconstriction, which increases the mean arterial pressure. The arterial cells of the kidneys sense the increase and signal the kidneys to increase urine output in an attempt to stabilize the pressure.

59. Which of the following animal bites is associated with

hypersensitivity and localized numbness?

- A) Scorpion
- B) Brown recluse spider
- C) Black widow spider
- D) Jellyfish
- E) Sea urchin

Answer: A

Scorpion stings can lead to hypersensitivity to touch in the area of the sting along with numbness, weakness, and localized erythema. Systemic symptoms, including hypersalivation, oculogyric crisis (multidirectional nystagmus), fasciculations, and pancreatitis, may also occur.

60. What is the most common complication of infective endocarditis?

- A) Septic emboli
- B) Congestive heart failure
- C) Splenic abscess
- D) Mycotic aneurysm
- E) Embolic CVA

Answer: B

Since infection involving the right side of the heart is less common, septic embolic are relatively rare. Complications of left-sided endocarditis include ring abscesses: these can lead to valvular destruction and result in congestive heart failure.

61. Which of the following is true regarding Osborn waves in hypothermia?

- A) Height of the Osborn wave is not proportional to the degree of

hypothermia

- B) Osborn waves are pathognomonic for hypothermia
- C) An Osborn wave is a negative deflection at the J point
- D) Osborn waves are typically more prominent in the precordial leads

Answer: D

Osborn waves are a positive deflection at the J point. Their height roughly correlates with the degree of hypothermia. They are not considered pathognomonic as they can also be seen with hypercalcemia and in patients with intracranial bleeding.

62. What is the standard of care for diagnosis of subarachnoid hemorrhage?

- A) CT head without contrast
- B) CT head with/without contrast
- C) CT angiogram head
- D) Lumbar puncture
- E) CT head without contrast and lumbar puncture

Answer: E

ACEP's clinical policy states: "In patients presenting to the ED with sudden-onset, severe headache and a negative noncontrast head CT scan result, lumbar puncture should be performed to rule out subarachnoid hemorrhage... Patients with a sudden-onset, severe headache who have negative findings on a head CT, normal opening pressure, and negative findings in CSF analysis do not need emergent angiography and can be discharged from the ED with follow-up recommended".

63. Which of the following are expected findings in patients with myxedema coma?

- A) Hybern timers
- B) Hyperthermia
- C) Hypercholesterolemia
- D) Hyperglycemia

Answer: C

Hypothyroidism causes an increase in total cholesterol levels. Hyponatremia, hypothermia, and hypoglycemia are other expected findings.

64. Which of the following statements is true regarding Trendelenburg position?

- A) The bed is placed at an incline so that the head is above the feet
- B) It has no role in the placement of a femoral central venous line
- C) It should be used routinely in patients with hypotension
- D) It can be of benefit in patients with hypertension

Answer: B

Trendelenburg positioning uses gravity to assist in the filling of the upper central veins when placing a central line in the subclavian or internal jugular veins. It has no role in the placement of a femoral central venous line.

Positioning involves placing the patient head down and elevating the feet. Current data to support the use of the Trendelenburg position during shock are limited and do not reveal any beneficial or sustained changes in systolic blood pressure or cardiac output - therefore its use is not recommended as part of routine practice.

65. Risk of thromboembolism is greatest at what stage of pregnancy?

- A) First trimester
- B) Second trimester
- C) Third trimester

D) Immediately postpartum

Answer: D

The risk of thromboembolism is highest during the immediate postpartum period.

66. Which of the following statements about the difference between *C. perfringens* and *S. aureus* food poisoning is correct?

- A) Symptoms for *S. aureus* typically start after six hours
- B) Symptoms for *C. perfringens* typically start after six hours
- C) Symptoms for both begin within six hours but *C. perfringens* typically lasts longer
- D) Symptoms for *C. perfringens* typically resolve within six hours

Answer: B

S. aureus food poisoning causes symptoms which begin *within 1-6 hours* and resolve within 6-8 hours. Food poisoning caused by *C. perfringens* is associated with poorly refrigerated or undercooked meat and symptom onset is *after 6-12 hours*.

67. Which of the following is a sign of an upper motor neuron lesion?

- A) Decreased muscle tone
- B) Fasciculations
- C) Atrophy
- D) Positive Babinski sign

Answer: D

Lower motor neuron lesions indicate that the lesion is either in the anterior

horn cell or distal to the anterior horn cell (in the peripheral nerve for instance). LMN lesions are characterized by decreased muscle tone, weakness and atrophy of the muscles supplied by that motor nerve, absent reflexes, and muscle fasciculations. Spasticity and presence of a Babinski reflex suggest an upper motor neuron lesion.

68. A child presents with itching around his anus. Which of the following statements is correct regarding this condition?

- A) All family members should be treated
- B) Stool cultures will be diagnostic
- C) Treatment involves a seven-day course of antibiotics
- D) This condition is self-limited and will resolve on its own

Answer: A

This child most likely has enterobius, also known as pinworms. Diagnosis is best achieved with the 'scotch tape test' in which worms are seen on the tape. Treatment involves a single dose of mebendazole and all family members should be treated.

69. A patient suffering from psychological trauma is considered to have what type of blast injury?

- A) Primary
- B) Secondary
- C) Tertiary
- D) Quarternary

Answer: D

Blast injuries are injuries resulting from direct or indirect exposure to an explosion. There are four classes. Primary injury includes cases of barotrauma and there are characteristically no external injuries. Secondary

injury is caused by damage from flying objects striking the body. Tertiary injury is a combination of blunt and penetrating trauma; for instance when the patient's body flies through the air and lands. Quarternary injury describes all others including smoke inhalation, chemical exposure, and psychological trauma.

70. Which of the following is true regarding use of continuous positive airway pressure in pulmonary edema?

- A) It has demonstrated reduction in mortality rates
- B) It can increase preload and decrease afterload
- C) It will reduce V/Q mismatch
- D) All of the above are true

Answer: C

CPAP has demonstrated reduced rates of intubation but has no demonstrable effect on mortality rate. Use of CPAP can decrease both preload and afterload and reduce ventilation/perfusion mismatch.

71. What is the most common cause of lower GI bleeding in children?

- A) Hemorrhoids
- B) Anal fissure
- C) Diverticulosis
- D) Trauma
- E) Meckel's diverticulum

Answer: B

Anal fissures are the most common cause of lower GI bleeds in children.

72. What is the most common cause of death in patients with congestive heart failure?

- A) Dysrhythmia
- B) Pulmonary embolism
- C) Sepsis
- D) Renal failure

Answer: A

Progressive hemodynamic decline leading to dysrhythmia is the most common cause of death in CHF patients.

73. Aspirin toxicity causes which of the following acid-base disturbances?

- A) Metabolic alkalosis
- B) Respiratory acidosis
- C) Metabolic acidosis with respiratory alkalosis
- D) Metabolic alkalosis with respiratory acidosis

Answer: C

In early stages, salicylate toxicity causes a respiratory alkalosis from tachypnea.

Classically, patients develop respiratory alkalosis with metabolic acidosis.

74. Which of the following statements is true regarding cluster headaches?

- A) They are classically bilateral
- B) Oxygen by nasal cannula is of little benefit
- C) Most attacks last for several days
- D) A prodrome is common

E) Pain is gradual in onset

Answer: B

Cluster headaches are characteristically acute in onset and without any prodrome. Patients will have unilateral pain with watery eyes and rhinorrhea. Patients typically experience multiple bouts of excruciating pain that can last up to 180 minutes. Cluster headaches are more common in males. Supplemental oxygen may be therapeutic *when given by 100% non-rebreather*.

75. What is the most common cause of superior vena cava syndrome?

- A) Hypertension
- B) Trauma
- C) Pulmonary embolism
- D) Malignancy

Answer: D

Superior vena cava (SVC) syndrome is most often caused by non-small cell lung cancer. Patients may present with shortness of breath, facial swelling, and periorbital edema. Dyspnea is the most common initial complaint.

76. What is the most specific finding for pericarditis?

- A) Chest pain that improves upon sitting forward
- B) Chest pain that worsens upon sitting forward
- C) Pericardial friction rub
- D) Diffuse ST elevation on EKG

Answer: C

The pain of pericarditis is typically relieved while sitting up and leaning forward, and worsened by laying supine. An audible friction rub is generated by friction of the two inflamed layers of the pericardium and carries specificity nearing 100%. The rub varies in intensity over time and is best heard at the left sternal border.

77. Activated charcoal is not beneficial for which of the following ingestions?

- A) Metoprolol
- B) Lithium
- C) Digoxin
- D) Salicylates

Answer: B

Charcoal will not bind to heavy metals/elements. Its true benefit is still being questioned but it can be used for other acute ingestions if administered within one hour. Potential side effects include vomiting and subsequent aspiration.

78. A patient suffers a crush injury to his lower leg. On exam there is extensive swelling and pain; x-rays reveal a comminuted tibial fracture. Compartment pressure is measured to be 24mmHg. What is the next best step?

- A) Discharge home with pain medication and good return precautions
- B) Admission to the hospital for serial checks
- C) Admission to the hospital for fasciotomy
- D) Observation in the ED for six hours

Answer: B

Indications for fasciotomy include an absolute compartment pressure $> 30\text{mmHg}$ or a difference of $< 30\text{mmHg}$ between the diastolic blood pressure

and the compartment pressure. Stated another way, perfusion within a compartment is only present when the diastolic blood pressure exceeds the intra-compartmental pressure. Pressures should be checked as close to the fracture site as possible.

79. What is the first sign of respiratory distress in infants?

- A) Tachypnea
- B) Tachycardia
- C) Intercostal retractions
- D) Bradypnea

Answer: A

Tachypnea is the earliest sign of respiratory distress in an infant or child.

80. Which of the following is associated with low output heart failure?

- A) Paget's disease
- B) Alcohol
- C) Thyrotoxicosis
- D) Pregnancy

Answer: B

Chronic alcoholism is associated with low output heart failure. Other causes include hypertension and ischemic cardiomyopathy.

81. A 60 year old female with a history of lung cancer has a headache for two weeks that is worse in the early morning. What is the most likely cause?

- A) Glioblastoma multiforme

- B) Meningioma
- C) Metastases
- D) Pseudotumor cerebri
- E) Astrocytoma

Answer: C

Metastases are the most common form of intracranial neoplasm. They are most often associated with lung cancer but can also be seen in patients with breast and colon cancer.

82. Sigmoid volvulus is classically associated with patients who have:

- A) Chronic constipation
- B) Hypothyroidism
- C) Type 2 diabetes mellitus
- D) Pernicious anemia

Answer: A

Sigmoid volvulus tends to occur in older adults who have chronic constipation. Patients typically have abdominal pain, obstipation, and distension. Sigmoidoscopy or colonoscopy can be diagnostic and therapeutic. Barium enema might be needed to establish a diagnosis showing a 'birds-beak' pointing to the site of obstruction. A rectal tube can be left in place for several days. Bowel is then prepped for elective sigmoid resection to avoid the high incidence of recurrence.

83. A 14 year old returns from a popular amusement park. In addition to some neat souvenirs, he brings home chicken pox. Which of the following medications is contraindicated?

- A) Acetaminophen
- B) Aspirin

- C) Acyclovir
- D) Oseltamavir

Answer: B

Aspirin use is contraindicated in patients under 18 years of age. Reye's syndrome can cause lethargy, encephalopathy, and even death.

84. After stepping on an unknown object, what type of foreign body warrants immediate removal?

- A) Metal
- B) Plastic
- C) Glass
- D) Wood

Answer: D

Wood and vegetative material should be removed from wounds because they are associated with increased risk of infection.

85. What is the preferred vasoactive agent to treat cold shock?

- A) Vasopressin
- B) Norepinephrine
- C) Dopamine
- D) Epinephrine

Answer: C

Hypotension is a late sign of shock in pediatric patients. Infants and children with sepsis often maintain blood pressure through an increase in heart rate and systemic vascular resistance. However they have a limited ability to

increase their stroke volume; as a result, infants and children are more likely to exhibit 'cold' shock in sepsis as opposed to hyperdynamic/vasodilated ('warm') shock seen in adults. The American College of Critical Care Medicine recommends IV fluids and dopamine as initial treatment.

86. Which of the following statements is true regarding Varicella pneumonia in adults?

- A) Patients with COPD are at higher risk
- B) Current guidelines recommend oral acyclovir for seven days
- C) It is radiographically indistinguishable from pneumococcal pneumonia
- D) Patients should initially be treated with the same antibiotics that would be used for community-acquired pneumonia

Answer: A

Adult chickenpox is complicated by some type of pulmonary involvement in 5-15% of cases. Risk factors for pneumonia include pregnancy, immunosuppression, COPD, smoking, and advanced age. Classic x-ray findings include multiple small nodules scattered throughout both lung fields. Treatment involves a seven day course of IV acyclovir.

87. Which of the following statements is true regarding blood pressure management in stroke patients?

- A) Patients with ischemic stroke should have their systolic lowered to between 160-180mmHg
- B) tPA candidates must have their pressure lowered to below 190/110mmHg
- C) Patients with hemorrhagic stroke should have their systolic lowered to between 140-160mmHg
- D) Unless the patient is a tPA candidate, blood pressure should not be lowered

Answer: C

Patients with ischemic stroke should not have their blood pressure lowered unless they are candidates for tPA. In such cases, the target pressure is < 185/110mmHg. Patients who suffer hemorrhagic stroke have a target systolic pressure of 140- 160mmHg.

88. Which of the following is a pre-renal cause of renal failure?

- A) Diabetes mellitus
- B) Nephrolithiasis
- C) Acute tubular necrosis
- D) Liver cirrhosis
- E) Transitional cell carcinoma of the bladder

Answer: D

Prerenal failure is the most common type of acute renal failure and results from hypoperfusion of the kidneys. This can result from dehydration, sepsis, severe burns, heart failure, or severe liver disease. Postrenal failure is the least common type of renal failure and usually results from an enlarged prostate (number one cause) or some type of bladder cancer.

89. What type of Salter-Harris fracture involves a fracture that extends along the physis into the metaphysis?

- A) Type I
- B) Type II
- C) Type III
- D) Type IV

Answer: B

Salter I is a separation of the epiphysis and physis from the metaphysis. Salter II involves the physis and extends into the metaphysis. Salter III is a

fracture involving the physis and epiphysis while Salter IV fractures are at the articular surface and extend through the epiphysis, physis, and metaphysis.

90. What is the most common bacterial pathogen associated with acute otitis media?

- A) *S. pneumoniae*
- B) *Moraxella catarrhalis*
- C) *S. aureus*
- D) *H. influenzae*

Answer: A

The most common cause of otitis media overall is eustachian tube dysfunction. The most common bacteria isolated is *S. pneumoniae*.

91. A 25 year old woman complains of left adnexal pain. Which of the following most increases the likelihood of her having an ovarian torsion?

- A) Tobacco use
- B) History of dysmenorrhea
- C) Presence of an ovarian cyst
- D) Previous C-section
- E) History of PID

Answer: C

Most cases of ovarian torsion are associated with ovarian cysts or with an ovarian tumor. For this reason, it is more common in women of reproductive age.

92. Which of the following medications has not been shown to reduce mortality in patients with ischemic cardiomyopathy?

- A) Aspirin
- B) Calcium channel blockers
- C) Statins
- D) ACE-inhibitors

Answer: B

Calcium channel blockers may actually increase risk of death in ischemic cardiomyopathy. Beta blockers, aspirin, and statins are the mainstays of therapy.

93. A 60 year old male with type 2 diabetes presents with hypoglycemia. His sugar is 40mg/dL upon arrival. He receives one ampule of D50 and his sugar rises to 100mg/dL. Two hours later his sugar is 50mg/dL. Which of the following medications is most likely responsible for his recurrent hypoglycemia?

- A) Metformin
- B) Glyburide
- C) Lantus insulin
- D) Regular insulin

Answer: B

Sulfonylureas such as glyburide promote insulin release independent of the body's blood glucose level. As a result, hypoglycemia is an expected side effect. With its relatively long half-life, recurrent hypoglycemia is a characteristic of glyburide.

94. A 15-year old girl presents to the ER complaining of vaginal bleeding. She reports a history of heavy periods for months and is

also feeling lightheaded and dizzy. Labs reveal a hemoglobin of 7.8. What is the most likely cause?

- A) Malignancy
- B) Urinary tract infection
- C) Sexually transmitted disease
- D) Uterine fibroids
- E) von Willebrand disease

Answer: E

Dysfunctional uterine bleeding in adolescents is most often due to anovulation or bleeding disorders, as opposed to adults where fibroids and polyps are more common. When there is sufficient bleeding to cause anemia, there is more likely to be an underlying coagulation disorder. von Willebrand disease is the most common inherited bleeding disorder.

95. A 65 year old female presents with painless loss of vision. Which of the following findings is seen with a central retinal vein occlusion?

- A) Cherry red spot
- B) Retinal hemorrhages
- C) Elevated intraocular pressure
- D) Nonreactive pupil
- E) Consensual photophobia

Answer: B

CRVO is associated with cotton wool spots and retinal hemorrhages.

96. Which of the following structures is found in zone 1 of the neck?

- A) Recurrent laryngeal nerve
- B) Parathyroid glands

- C) Thyroid gland
- D) Thymus

Answer: D

Zone 1 structures include the proximal common carotid and vertebral arteries, trachea, esophagus, thoracic duct, and thymus. The remainder are located in zone 2.

97. Which of the following bones is most prone to avascular necrosis?

- A) Talus
- B) Mandible
- C) Cuboid
- D) Fibula

Answer: A

Bones that receive tenuous blood supply include the scaphoid, femoral head, odontoid, and talus. These bones are therefore particularly prone to develop avascular necrosis.

98. A 45 year old male presents with disorientation and drowsiness. He is able to answer questions. Physical examination reveals asterixis. What stage of hepatic encephalopathy does this represent?

- A) Stage 1
- B) Stage 2
- C) Stage 3
- D) Stage 4

Answer: B

Hepatic encephalopathy patients are 'graded' from stage 1-4. Stage 2 is characterized by disorientation, drowsiness, and asterixis. Stage 4 is associated with coma and posturing.

99. A scuba diver loses consciousness while ascending. Which of the following is the most likely cause?

- A) Caisson's disease
- B) Air embolism
- C) Decompression sickness
- D) Nitrogen narcosis

Answer: C

Caisson's is not associated with loss of consciousness; rather patients may have periarticular pain. Divers who suffer from nitrogen narcosis actually improve with ascent. Air embolism causes loss of consciousness while ascending or within 10 minutes of surfacing.

100. What is the most common exam finding in patients with aortic dissection?

- A) Hypotension
- B) Asymmetric upper extremity blood pressures
- C) Orthostatic hypotension
- D) Pulse deficit
- E) Hypertension

Answer: E

Hypertension is the most common exam finding in acute aortic dissection.

101. A 26 day old infant presents with a temperature of 100.6°F. Lumbar puncture reveals 680 WBC, 5180 RBC, and a negative gram stain. What is the most appropriate next step?
- A) Discharge home with close follow-up
 - B) Ceftriaxone 50mg/kg IM and discharge home
 - C) Ceftriaxone 50mg/kg IV and admission
 - D) Ampicillin 50mg/kg IV and cefotaxime 50mg/kg IV

Answer: D

Treatment for neonatal meningitis is ampicillin 50mg/kg and cefotaxime 50mg/kg.

102. Which of the following indicates that a patient should be transferred to a liver transplant center following an acute acetaminophen overdose?
- A) Creatinine 2mg/dL
 - B) INR 5.0
 - C) Blood glucose > 500
 - D) Blood glucose < 60
 - E) pH 7.1 on ABG

Answer: B

Liver transaminases (AST, ALT) are indicative of liver damage but do not convey any information regarding liver function. PT/INR should be monitored to assess liver function, especially any time N-acetylcysteine is started. If the patient's acidosis responds to IV fluids, then of all the options given, the raised INR is the best indication for referral to a transplant center.

103. A 50 year old man is receiving IV vancomycin for an extensive skin infection when he develops lightheadedness and a rash over his face

and chest. What is the next best step?

- A) Slow the infusion rate
- B) Stop the infusion
- C) Administer benadryl and slow the infusion rate
- D) Administer benadryl and stop the infusion
- E) Administer epinephrine and stop the infusion

Answer: D

‘Red man syndrome’ is an anaphylactoid reaction to vancomycin. Patients will have intense pruritis and a rash that affects the face, neck, and/or torso. It occurs secondary to a histamine release and is therefore best treated with antihistamines such as benadryl. The vancomycin infusion should be stopped and can be restarted at a slower rate after the symptoms have resolved.

104. Which of the following helps differentiate a sympathomimetic crisis from an anticholinergic crisis?

- A) Tachycardia
- B) Miosis
- C) Altered mental status
- D) Fever
- E) Diaphoresis

Answer: E

Anticholinergic toxicity produces dry skin; sympathomimetics are associated with diaphoresis. This is the key to differentiating these two toxidromes.

105. Which of the following is true regarding intraosseus access?

- A) The proximal humerus allows for rapid infusion rates and less infusion- related pain

- B) The distal tibia is the preferred insertion site for pediatric patients
- C) Medication dosages should be doubled
- D) Failed placement of an intraosseus line in a bone is not a contraindication to re-attempting placement at a different site in the same bone

Answer: A

While the sternum technically allows for the most rapid infusion rate, placing an IO in the sternum requires a special device. The proximal humerus allows for the next- fastest infusion rates. The proximal tibia is the preferred site of intraosseus access in children. Medication dosages are the same as you would order through a peripheral or central IV.

106. Which of the following foreign bodies should be most emergently removed?

- A) Coin in the esophagus
- B) Chicken bone in the stomach
- C) Button battery in the stomach
- D) Needle in the esophagus

Answer: D

Any sharp or pointed object in the esophagus warrants endoscopic removal. Button batteries that have passed into the stomach should be removed if the patient displays symptoms. Otherwise they can be managed expectantly.

107. Which of the following statements is true regarding healing by tertiary intention?

- A) Patients will have less of a scar than if the wound healed by secondary intention
- B) Tertiary intention is particularly useful for managing animal bites

- C) Dirty or contaminated wounds, in general, should be allowed to heal by tertiary intention
- D) All of the above are true

Answer: D

Healing by tertiary intention is also known as ‘delayed primary closure’. It is particularly useful in patients with contaminated wounds and in those who suffer from animal bites (ie those patients in whom primary repair is not indicated). By day three, macrophages have been activated and phagocytosis is underway – at this point patients can return to the ER for wound closure if indicated. Repair by secondary intention is allowing the wound to heal on its own, and often leaves a significant scar.

108. A previously healthy 15 month old boy presents with a fever. He is diagnosed with a UTI. Oral antibiotics are started and symptoms improve. The urine culture ultimately grows out E. coli. What should be done next?

- A) Voiding cystourethrogram
- B) Repeat urine culture after antibiotics are finished
- C) Renal ultrasound
- D) Routine follow up with primary care physician

Answer: D

The AAP updated its guideline in 2011 to no longer recommend routine voiding cystourethrogram after a first urinary tract infection. Repeating urine cultures after antibiotics are completed is also no longer recommended.

109. A patient is cutting wood when he feels something enter his eye. He has immediate pain. CT of the orbits is unremarkable. What is the next best imaging study for evaluation of potential intraocular foreign

body?

- A) Plain film
- B) Ultrasound
- C) MRI
- D) No further imaging is needed since the CT scan was normal

Answer: C

Intra-orbital wood is often not detected by plain film or CT scan. Organic foreign bodies need to be removed; therefore MRI should be performed if there is sufficient clinical concern.

110. Which of the following infections can be transmitted from person to person?

- A) *S. typhi*
- B) *B. anthracis*
- C) *C. neoformans*
- D) *F. tularensi*

Answer: A

S. typhi causes typhoid fever. It is spread by eating food or drinking water contaminated with the feces of an infected person.

111. Which of the following is true regarding digoxin toxicity?

- A) In acute toxicity, the degree of hyperkalemia correlates with mortality
- B) Serum digoxin levels correlate with toxicity
- C) The most common rhythm disturbance is atrioventricular block
- D) Hyperkalemia increases susceptibility to the toxic effects of digoxin

Answer: A

Serum digoxin levels do not correlate with toxicity. Asymptomatic patients can have a 'toxic' level while truly toxic patients may have a 'normal' level. Hypokalemia can increase susceptibility to the toxic effects of digoxin. PVCs are the most common rhythm disturbance.

112. What is the recommended management for alveolar osteitis?

- A) Oral antibiotics
- B) IV antibiotics
- C) Removal of debris from the socket
- D) Bone biopsy for definitive diagnosis

Answer: C

Alveolar osteitis, also known as dry socket, is a postoperative complication of tooth extraction. Pain typically develops on the second to fourth day after extraction. It occurs when the blood clot fails to form or is lost from the socket. This leaves an empty socket where bone is exposed to the oral cavity. Treatment is mostly symptomatic and antibiotics are unnecessary. Debris should be removed from the socket by gentle warm saline irrigation. Medicated dressings (eugenol) are sometimes inserted into the socket for severe pain. Antibiotics are unnecessary unless there is concern for infection.

113. What is the most common cause of death in recipients of a transplant?

- A) Infection
- B) Malignancy
- C) Rejection
- D) Drug toxicity

Answer: A

Given that patients take such high-dose immunosuppressants, infection is the most likely cause of death following organ transplant. CMV is the most common isolate one to six months after transplant.

114. A 2 year old is brought in by parents for evaluation of sudden onset abdominal pain with intermittent periods of appearing well. Which of the following is true regarding the most likely diagnosis?

- A) It is the most common cause of intestinal obstruction in children aged three months to six years
- B) The majority of cases require operative repair
- C) Patients often present with bloody stools
- D) The diagnosis is most commonly made with plain films

Answer: A

Intussusception is the most common cause of intestinal obstruction in children younger than three years of age. Diagnosis is often confirmed by ultrasound and bloody stools are considered a late finding.

115. A 35 year old man fractures his clavicle while wrestling his grandmother. X-ray shows a displaced fracture of the midshaft of the left clavicle with significant shortening. What is the best treatment?

- A) Shoulder sling
- B) Closed reduction
- C) Open reduction/internal fixation
- D) NSAIDs and range of motion as tolerated

Answer: C

Operative repair is indicated if any of the following are present: neurovascular compromise, skin tenting, widely displaced fractures, or significant shortening.

116. A 25 year old woman presents with intermittent dizziness, weakness, and ataxia for several weeks. She has had eye pain and vision loss in her right eye. An outpatient MRI report is suggestive of multiple sclerosis. What is the most appropriate next step in management?

- A) IVIG
- B) Plasmapheresis
- C) Oral steroids
- D) IV steroids

Answer: D

This patient has optic neuritis and should receive IV steroids. Oral steroids are associated with an increased risk of recurrent optic neuritis.

117. A patient remains in ventricular fibrillation despite 1 shock and 2 minutes of continuous CPR. What is the next best step?

- A) Amiodarone
- B) Epinephrine
- C) Lidocaine
- D) Administer a second shock

Answer: D

Electrical defibrillation is the most successful treatment for VFib. Give the shock as quickly as possible - immediately after shock delivery, resume CPR for two minutes. At that point reassess the patient and administer another shock if VFib persists.

118. Which of the following is a known complication of ischemic central

retinal vein occlusion?

- A) Keratitis
- B) Corneal ulcer
- C) Glaucoma
- D) Endophthalmitis
- E) Retinal detachment

Answer: C

CRVO may present initially as the ischemic type, or it may progress from nonischemic. Ischemic CRVO is the severe form of the disease. Ischemic CRVO typically presents with significant vision loss and poor perfusion to the retina. Patients may develop neovascular glaucoma and a painful blind eye.

119. A child is playing outside when he is bitten by a fox. The animal runs off before it can be caught and the child is brought to the hospital with a laceration to his right leg. Which of the following statements regarding his treatment is correct?

- A) The first step is to administer rabies immunoglobulin
- B) Rabies vaccine should not be administered in the gluteus
- C) Post-exposure prophylaxis is only effective if administered within seven days
- D) Rabies immunoglobulin and vaccine are not necessary

Answer: B

The first step is to wash the affected area with soap and water. In previously unvaccinated individuals, rabies immunoglobulin should be given with as much of the full dose as feasible infiltrated around the wound and the remainder given intramuscularly. As per the CDC, the rabies vaccine should never be administered in the gluteus since antibody responses have been shown to be lower.

120. A mother brings her four week old child for post-prandial projectile vomiting. He is afebrile and has normal vital signs. Electrolytes are:

NA 133

K 3.3

Bicarbonate 31

Chloride 90

BUN 20

Creatinine 1.2

Which antibiotic is associated with the development of this condition?

A) Erythromycin

B) Cephalexin

C) Tetracycline

D) Ciprofloxacin

E) Penicillin

Answer: A

This patient has hypokalemia and a hypochloremic metabolic alkalosis. Combined with a history of post-prandial projectile vomiting, this presentation is typical for pyloric stenosis. Abdominal ultrasound is the diagnostic test of choice. Macrolides have been associated with development of infantile hypertrophic pyloric stenosis.

121. A 60 year old male complains of back pain and loss of sensation in his right leg. A stat MRI confirms the diagnosis of cauda equina syndrome. Which of the following findings is most likely present?

A) Saddle anesthesia

B) Urinary retention

C) Hyporeflexia in the lower extremities

D) Fecal incontinence

Answer: B

The most consistent finding in patients with cauda equina syndrome is urinary retention, often causing what is known as 'overflow incontinence'. While saddle anesthesia and fecal incontinence may also be seen, urinary retention has a sensitivity of almost 90%.

122. A skeletal survey includes all of the following except:

- A) Two views of the skull
- B) Lateral view of the thoracic spine
- C) Lateral view of the lumbar spine
- D) Lateral view of the forearm

Answer: D

The skeletal survey imaging protocol that has been developed by the American

College of Radiology includes: AP views of the arms, forearms, hands, thighs, legs, feet, abdomen, and pelvis; AP *and* lateral views of the cervical, thoracic, and lumbar spine as well two views of the skull.

123. Which foodborne disease typically causes symptoms within 24 hours?

- A) Campylobacter
- B) B. cereus
- C) Salmonella
- D) V. cholera

Answer: B

B. cereus typically causes symptoms within the first 24 hours. The illness usually lasts less than 24 hours after onset. Salmonella appears 6-72 hours after ingestion and lasts 3-7 days without treatment.

124. In which of the following cases is sodium bicarbonate indicated for the treatment of DKA?

- A) Potassium > 5.4 mEq
- B) pH < 7.0
- C) pH < 6.9
- D) Sodium < 120 mmol/L
- E) Sodium bicarbonate is not indicated in the treatment of DKA

Answer: E

Both the NIH and American Diabetes Association no longer recommend administering sodium bicarbonate in diabetic ketoacidosis. Studies have shown that it does not decrease time to resolution of acidosis or time to hospital discharge, even in patients with a pH < 7.0 .

125. What is the earliest sign of impending herniation in a patient with severe traumatic brain injury?

- A) Hypertension
- B) Hypotension
- C) Bradycardia
- D) Tachycardia
- E) Tachypnea

Answer: C

In patients with increased intracranial pressure and impending herniation, Cushing's triad refers to a constellation of signs that may be seen: hypertension, bradycardia, and irregular respirations. Of these, bradycardia is the earliest sign.

126. When performing procedural sedation in the ER, what is the minimum number of qualified providers that should be present?

- A) One physician for the sedation, one for the procedure, and one nurse
- B) One physician for the sedation and procedure, and one nurse
- C) One physician for the sedation and procedure, and two nurses
- D) One physician is the minimum number of providers that can be present

Answer: B

One physician needs to be present for the procedure and at least one nurse should be present for continuous monitoring of the patient.

127. What is the first medication that should be administered to a patient with suspected digoxin toxicity and hyperkalemia?

- A) Calcium chloride
- B) Calcium gluconate
- C) Fab fragments
- D) Sodium bicarbonate
- E) Kayexalate

Answer: C

Once treatment with digoxin-specific antibody (Fab) fragments is started, hyperkalemia is rapidly corrected. Aggressive treatment with potassium-lowering agents on top of Fab can actually cause hypokalemia. Theoretically, administration of calcium to patients with digoxin-induced hyperkalemia can lead to 'stone heart'. This is no longer believed to be true. Remember that hypokalemia exacerbates digitalis toxicity, so potassium (if levels are low) may actually need to be administered along with Fab fragments.

128. A 50 year old woman presents with fever, chills, nausea, and right-sided CVA tenderness. Vitals are as follows: temperature 103oF, BP 90/70mmHg, and heart rate 120. IV fluids and antibiotics are started. CT scan shows a right-sided proximal ureteral stone with hydronephrosis. What is the most appropriate next step in management?

- A) Continue medical management with fluids and antibiotics
- B) Open surgical stone extraction
- C) Shock wave lithotripsy
- D) Percutaneous nephrostomy

Answer: D

This patient has a ureteral stone with proximal ureteral obstruction resulting in hydronephrosis and hemodynamic instability. Immediate intervention is necessary. Drainage via percutaneous nephrostomy or retrograde ureteral stent is indicated for stabilization.

129. What is the most common cause of death after bariatric surgery?

- A) Pulmonary embolism
- B) Small bowel obstruction
- C) Anastamotic leak
- D) Suicide
- E) Pneumonia

Answer: C

The most common cause of death after bariatric surgery is peritonitis from an anastomotic leak. This is typically an early complication – diagnosed within 10 days of surgery.